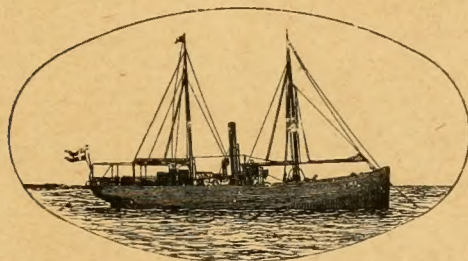


Report
of
The Danish Biological Station
to
The Board of Agriculture.



XVI.
1908.

By
C. G. Joh. Petersen,
Ph. D.

Translated from „Fiskeri-Beretning for 1907“.

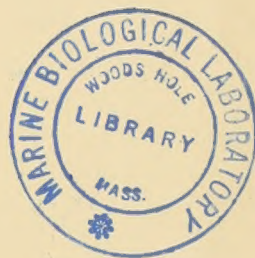
Copenhagen.
Centraltrykkeriet.
1908.



From

The Danish Biological Station.

XVI.



1908.

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Contents.

On the Ecology and Distribution of the Grass-Wrack (*Zostera marina*) in Danish Waters. XVI.
C. H. Ostenfeld.



On the Ecology and Distribution of
the Grass-Wrack (*Zostera marina*)
in Danish Waters.

Motto: It is certainly this plant which for a
great part conditions the fish-wealth of
our coasts.

(Dr. C. G. Joh. Petersen in Beretning fra den
danske Biologiske Station I, p. 168)

(With 9 figures.)

By
Dr. C. H. Ostenfeld.

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I. Introduction.

At the request of Dr. C. G. Joh. Petersen, Director of the Danish Biological Station, the author made a three weeks cruise in Danish waters within the Skaw on board the Biological Station's steamer »Sallingsund« in July and August 1901, in order to investigate the distribution of the eel-grass or grass-wrack and to study the ecology of this plant. As assistant at the Biological Station I had already the year before taken much interest in the grass-wrack, the extensive growth and distribution of which is of much importance to our fisheries. The following pages show the results of my investigations. Unfortunately, I have been so much occupied by other work that this report is only now completed six years later; yet a very brief summary of the most important results has already been published in the »Botanisk Tidsskrift« (Vol. 27, December 1905, pp. 123-125).

The grass-wrack (*Zostera marina* L.) being such a common and peculiar plant, it is only natural that many investigations of various kinds should have been published regarding it. The object of my investigations has therefore mostly been to extend our knowledge of the conditions of the growth and occurrence of this plant in the Danish seas and less to study the structure, life or biology of the plant itself. In the first and third reports of the Biological Station (1891 and 1893), Dr. C. G. Joh. Petersen has already recorded similar investigations, made in Holbæk Fjord and the Little Belt; further information on the distribution of the eel-grass in the Kattegat is to be found in: »Det videnskabelige Udbytte af Kanonbaaden Hauchs Togter« (København 1893, pp. 437—438). In all three publications the text is accompanied by several charts showing the distribution. Information on this subject may also be gathered from later reports of the Biological Station (especially Reports IX and X, 1900 and 1901). With regard to our Baltic shores, lastly, it may be mentioned that in his paper on the »Algenflora der westlichen Ostsee deutschen Antheils« (6. Bericht der Komm. zur wissensch. Unters. der deutschen Meere in Kiel, 1889) Prof. J. Reinke of Kiel has discussed the eel-grass vegetation off the Schleswig side of the Little Belt and in Kiel Bay.

A work of great importance but of a somewhat different kind is the »Dansk Plantevækst, I, Strandvegetation« lately (1906) published by Prof. Eug.

Warming, the 12th chapter of which deals with the »sea grasses« (pp. 183—198); in this the life-history, structure and distribution of the grass-wrack are discussed thoroughly.

Of important sources of information from the purely botanical side concerning our plant may be mentioned: C. Raunkiær's work »De danske Blomsterplanter Naturhistorie«, Vol. I, (1895—99), in which the structure of the eel-grass is described (pp. 120—125) and the paper by Ch. Flahault on *Zostera* in O. Kirchner, E. Loew and C. Schroeter: *Lebensgeschichte der Blütenpflanzen Mitteleuropas*, Bd. I, Lief. 6, (1906, pp. 516—529). All these papers contain a copious literature to which I may refer any one desirous of further information respecting the natural history of the eel-grass.

Lastly, I would draw attention to a small interesting pamphlet called (translated into English): *The use of Grass-wrack for stuffing pillows and mattresses and its proper treatment for such purposes as a substitute for horse-hair*, written by M. C. G. Lehmann (Kjøbenhavn 1812) and to an enlarged German edition a few years later (1814) entitled: »*Der entdeckte Nutzen des Seegrases zum Füllen der Küssen und Polster*«, von Dr. M. C. G. Lehmann (Kopenhagen bei Schubothé). The author recommends the use of the dried leaves of the eel-grass for stuffing mattresses and the like. He concludes the German edition by saying that the eel-grass »gewährt ein Lager, weicher als Heu, gesunder als Federn, dauernder als Stroh, wohlfeiler als sie alle.« It is also now-a-days a well-known fact that the leaves of the eel-grass are extensively used in this way, and Dr. Lehmann is evidently of opinion that he has had the honour of discovering this use. In reference to this, I may mention that most of the roofs of the houses on Læsø are still thatched with dried eel-grass instead of straw and that elsewhere in our country the same material is also made use of to make the ridges of the roofs water-tight.

Eel-grass may also be used as manure, mostly perhaps on account of the substances entangled in it (sea-algæ, dead molluscs, snails etc.); as the leaves themselves have an unusual power of resistance against crumbling.

It is however the importance of the grass-wrack to the sea and its fauna and not to the land that we shall deal with here.

Botanisk Museum, Kopenhagen, March 1907.

II. Structure and growth of the *Zostera*.

If one rows along in a boat at low water in almost calm weather and looks down upon the dark-green vegetation of the grass-wrack, one only catches sight of the long ribbon-like leaves waving hither and thither with the motion of the water. In summer-time the flower-bearing shoots, which will be described later, are also sometimes visible. In order to investigate the plant more closely a few shoots may be loosened by means of a rake, an oar or a dredge. It is then seen, that the leaves are placed on a jointed and brittle root-stock, which has been growing horizontally creeping in the bottom of the sea, a little below the surface of the ground. The leaves are placed in two rows, alternately to the right and to the left, and each leaf consists of a lower tubular part, called a sheath, which encloses the younger part of the shoot, and the long flat, ribbon-like blade. The older leaves of a shoot are placed on the root-stock with a space of 1—2 cm. between them, and the places where the leaves arise give the latter a nodose appearance, as each sheath forms a projecting ring or ridge. At the base of the sheath two tufts of rather long, branchless, white roots develop, fastening the plant to the bottom. Towards the end of the shoot the internodes of the root-stock are quite short and are only seen if one leaf after another is picked off; it is here that the shoot is growing. At some places side-shoots are found; there is in reality a small bud in the corner of each leaf, which is the germ of a side-shoot, yet only very few of these will develop. From a botanical point of view the position of the buds is rather peculiar, as they are not placed right down in the axil, i. e. just inside the base of the sheath, but a little higher, just below the base of the next sheath. We have no explanation of this peculiarity; it is perhaps because it would be difficult for the small bud to find room inside the base of the sheath. The side-shoots develop into shoots of the same kind as the mother-shoot, and as each of the shoots only consists of some few nodes, the root-stock gradually dying away from behind or easily broken, the side-shoots soon develop into independent branching shoots. It is thus easily understood that in this way a multitude of shoots are formed which weave together the thick carpet of which the *Zostera* vegetation consists.

Grass-wrack is green all the year round and luxuriates in the warm and

bright summer-time; the summer leaves are longer than the winter leaves. Each shoot has always 3 to 6, most often 4 or 5, full-grown leaves and behind these some sheaths which have lost their blades. As shown distinctly by the present photos (Figs. 1 and 2), it is characteristic that the blades are thrown off at their base, whereas the sheaths remain for a long time and only gradually decay, leaving nothing



Fig. 1. Leaf-bearing shoot of broad-leaved grass-wrack (*Mud-Zostera*). At *x* the blades of the older leaves have been thrown off so that only the sheath is left; *S* is a side shoot. (Soft bottom, 2 fathoms, Kors-havn at Fynshoved, 25. May 1900.)

but the strings as loose fibres. The largest quantity of leaves is thrown off during the autumn in September—October, when the autumnal gales set in causing a rough sea; and as the summer-leaves are besides the longest, it is evident, that the autumn gives the greatest mass of loose leaves. It is also a well-known phenomenon that in the autumn loose leaves of eel-grass as also whole shoots are found floating about in the sea in quantities. This large drift which is further increased by the seine-fisheries, is partly washed ashore, making large mounds (»Eve« or »Erve«) along the beach, and partly sinks to the bottom, where extensive accumulations of »dead-weed« are formed, especially in deep water in holes, channels and calm inlets. The »dead-weed« will be a little more closely discussed later.

The reason why the loose leaves of the eel-grass first float in the water and afterwards sink down is, that the fresh leaves or those just thrown

off contain so much air, that it makes them float. It is also on account of this air, that the leaves of the growing eel-grass point upwards in the water; as the leaves are extremely flexible, they would in the absence of air in the blade lie flat along the bottom of the sea, which would be quite purposeless in all respects. If a leaf is held up to the light and investigated more closely, it is seen that inside it some fine strings run lengthways in the blade; their number varies from 3 to 7, but the number of strings in one leaf is the same in the whole of its length. The purpose of these strings, which are connected with one another by some still finer cross-fibres, is to act as conductors for the nutriment of the leaf. Between the

longitudinal strings some stripes more or less broken and often like a string of pearls are visible; against the light they are dark, but with the light falling upon them they are whitish or light green, being covered by the outer green skin of the leaf; these are rather long and very narrow cavities filled with air. It is easily ascertained that they contain air by holding a bit of leaf in water and pressing it between two fingers; air bubbles rise from it.

In order to learn how many leaves are produced by the *Zostera* in the course of a year, I have made a great many measurements. It is not easy to determine how much the plant grows and how many leaves it develops, as, apart from the length, the leaves are alike all the year round and at any rate apparently have no resting period like our land plants, and further, as it is impossible to mark the root-stock of a certain plant on its natural place at the bottom of the sea and inspect it in order to follow its growth. Nor has the eel-grass like our trees any fixed rule of branching which tells us that normally the shoot is branchless the first year and gets branched the next, so that the age of a branch may be determined.

I have tried to clear up these questions by investigating a certain number of shoots collected at a certain place and depth once a month throughout a whole year.

I am indebted to Dr. C. G. Joh. Petersen for kindly enabling this investigation to be carried out, as it would have been quite impossible for me personally to have collected the material month by month. In 1901 the Biological Station had its head-quarters at Nyborg, and I chose for the investigation a place in Nyborg Fjord off Hølekenhavn where I found a rich growth of grass-wrack from $3\frac{1}{2}$ fms. to inshore ($\frac{1}{4}$ — $\frac{1}{2}$ fms.). At a depth of $3\frac{1}{2}$ —2 fms. the bottom was soft, whereas it was hard at $1\frac{1}{2}$ — $\frac{1}{4}$ fms., the grass-wrack being accordingly



Fig. 2. A, Leaf-bearing shoot; x shows the place where the blade has fallen off. B, Flower-bearing shoot from the same place. (Sand bottom, Smaaland waters, Omo Bank, ca. 2 fms., 7. August 1901).

— as will be further mentioned later — long and broad-leaved on the soft bottom, narrow and short on the hard bottom. When I chose the place, I decided to collect the material at a depth of $3\frac{1}{2}$, $2\frac{1}{2}$, $1\frac{1}{2}$ and $\frac{1}{2}$ fms., which was also carried out by myself as well as by the Biological Station's fisherman, who accompanied me on my first expedition in August 1901 and received exact information as to the place and depth. He then undertook to collect the grass-wrack until the Biological Station's steamer left Nyborg in the beginning of March 1902. Then a fisherman at Nyborg was instructed by the Biological Station's fisherman to collect the eel-grass, which he did until he was able to complete the collection

Table I.**The channel off Holckenhavn.**Hard bottom, $\frac{1}{4}$ — $1\frac{1}{2}$ fms.

Date 1901—02.	The length of the longest leaf incl. sheath in cm. (Each number corresponds to one plant.)	Aver- age.	Breadth of the leaf in mm.
9—VIII.	30 50 43 50 45 28 50 50 45 28 30 33 55	41	2,5—3,5
18—IX.	33 58 43 75 60 75 77 65 60 58 78	62	2,5—3,5
15—X.	80 70 70 55 63 65	67	
14—XI.	93 110 70	91	3,0—3,5
15—XII.	58 58 60 53	57	2,5—2,8
15—I.	58 58 55	57	3,0—4,0
15—II.	73 85 60	73	3,0—4,0
19—III.	65 60 68	64	2,5—3,0
17—IV	63 60 58 65	61	3,0—3,5
15—V.	37 31 36 64 66 50 43	49	3,0—4,5
15—VI.	41 48 38	42	3,5—4,0
15—VII.	76 73 63	71	3,0—3,5
15—VIII.	75 62 74	70	3,5

in August. The frequent change of collectors has unfortunately caused some uncertainty and heterogeneity in the material and I have therefore decided to reduce the 4 divisions to 2 according to the nature of the bottom.

The present tables (Tables I—IV), the result of this investigation, contain information which will facilitate the solution of the questions stated above.

¹⁾ As the depth on our charts is nearly always given in fathoms I have for practical reasons been obliged to use this unity for the investigation; in the following table I give the equivalents of fathoms in meters:

$\frac{1}{2}$ fm. = 0,9 meters.
 1 — = 1,9 —
 $1\frac{1}{2}$ — = 2,8 —
 2 — = 3,8 —
 $2\frac{1}{2}$ — = 4,7 —
 3 — = 5,6 —

$3\frac{1}{2}$ fm. = 6,6 meters.
 4 — = 7,5 —
 $4\frac{1}{2}$ — = 8,5 —
 5 — = 9,4 —
 $5\frac{1}{2}$ — = 10,4 —
 6 — = 11,3 —

If we are to make any use of these measurements, it is necessary that all the *Zostera* shoots at a certain place should be almost the same in size and length of the leaves. On looking down upon the wavy field of grass-wrack in the water, this supposition should seemingly be easy to fulfil; grass-wrack is very much like a corn field in which the plants are generally almost equal in size, and though the variations are large the numbers in the tables show that the hypothesis is to some extent correct. It seems however that in this respect there is some difference in the *Zostera* vegetation when growing in low water and on hard bottom or in deep water and on soft bottom.

Table II.**Channel off Holckenhavn.**Soft bottom, $2\frac{1}{2}$ — $3\frac{1}{2}$ fathoms.

Date 1901—02.	The length of the longest leaf incl. sheath in cm. (Each number corresponds to one plant).	Average.	Breadth of the leaf in mm.
9—VIII.	120 105 140 130 145 100 130 185 230 200 208 225	160	5,0—7,5
18—IX.	105 113 125 130 125 170 155 200 180 223 185 163		
	198 165 150	159	5,0—8,0
15—X.	98 110 165 198 175 163	152	
14—XI.	105 105 93 85 153 160 153	122	4,5—6,5
15—XII.	75 105 90 105 130 95	100	6,0—6,5
15—I.	88 100 85 123 125 148	112	5,0—6,5
15—II.	130 93 85 65 73	89	4,5—6,0
19—III.	105 100 90 80 100	95	4,5—6,0
17—IV.	113 118 138 113 80	112	4,5—6,0
15—V.	82 60 64 75	70	4,5—5,0
15—VI.	104 86 170 152 130 117 138	128	5,5—7,0
15—VII.	215 125 160 185 195 190	178	6,5—8,0
15—VIII.	155 215 240 170 190 170 245 230 230	205	6,5—8,0

In Table I the length of the longest leaf of some shoots from low water and hard bottom is given in cm. together with the breadth of the leaf in mm. The number of specimens (shoots) measured is rather variable and generally too small, but unfortunately for practical reasons no more shoots were at my disposal, partly because the collecting work had to be fairly easy to undertake, partly because many of the leaves of the specimens sent were defective (the tips were broken) rendering it impossible to decide which had been the longest.

The measurements from August and September are however so numerous, that they show the extent of the variations, from which one can judge of the value of the average. It appears from these that the variations are so considerable, that the average must be used with caution and only as an approximate number. The Table further shows that neither the numbers of the individual measurements nor the averages vary in any certain direction, they rise and fall quite casually and after having studied the Table we can only say that the eel-grass in low water and on hard bottom seems rather invariable in the course of the year as regards the length of leaves. The breadth of the leaves only shows slight variations, such as from 2,5 to 4,5 mm., and is also uninfluenced by the time of year.

Turning to Table II, measurements of the longest leaf of plants which have been growing on soft bottom in deep water, we come to quite different results. It is first observed that the leaves are much longer here than on hard bottom and in low water, 60—245 cm. as compared with 28—110 cm., which is more than twice as long; the breadth is likewise much greater (4,5—8,0 mm. as compared with 2,5—4,5 mm.). The variations in the measurements for a single

Table III.**Channel off Holckenhavn.**

Hard bottom, $\frac{1}{4}$ — $1\frac{1}{2}$ fathoms.

The length of all the leaves of some plants (in cm.);
each line corresponds to one plant.

1901—02	Outermost — Innermost leaf.
18—IX.	63 68 78 85 38 3
15—X.	80 78 65 43 20 65 70 65 50 40 18 70 65 55 43 15
14—XI.	93 70 63 20 110 85 80 45 5 70 55 55 15
15—XII.	55 58 40 18 58 52 45 23 50 60 48 23 53 48 48 40 25
15—I.	58 58 48 28 13 58 53 45 28 10 55 53 48 33 13
15—II.	65 73 60 40 18 85 70 40 13 55 60 40 20
19—III.	65 50 38 23 8 60 50 — 20 8 68 48 30 18 6
17—IV.	63 40 25 20 10 60 40 30 15 8 58 45 35 28 18 65 48 33 18 5
15—V.	37 32 30 28 22 8 28 26 29 31 20 6 — 36 28 28 28 15 64 38 38 21 6 66 66 66 60 38 50 47 45 43 39 20 43 39 35 — 24 14
15—VI.	30 29 34 41 38 22 29 37 48 47 25 24 29 38 34 18
15—VII.	36 48 60 67 76 62 25 — — 53 64 73 65 28 40 50 57 63 63 50 20
15—VIII.	68 75 75 54 15 58 62 61 52 22 57 68 74 67 36

date are also large here, so that the averages are very uncertain, but on Table II they vary in a definite direction: they are highest in summer, lowest in spring and winter. From this we may conclude that the leaves are longest in the warm summer time, July—September, when they are generally upwards of 150 cm. long. From September they decrease in length, i. e. the longest leaves are thrown off and the new ones grown are not so long; in winter they are only ca. 100 cm. long. In spring they are also comparatively short, though the unusually low numbers from the 15th of May are accidental, and the longer leaves develop only in June; lastly, in mid-summer (July—August) the leaves reach their maximum length. We may therefore say that the leaves of the *Zostera* vegetation in deep water and on soft bottom are much longer in summer than in winter and spring. The Table further shows that with increasing length of the leaves in summer follows their greater breadth.

The Tables III and IV come from the same collections; they contain measurements of the length of all the leaves of some plants, arranged so that each line corresponds to one specimen; the first number (to the left) gives the length of the outermost leaf, the next that of the following leaf etc. to lastly, that of the innermost leaf not yet full grown. Each month 3—7 specimens were measured and the number which marks the longest leaf of each specimen is accentuated; a dash instead of number means that the leaf in question was defective on account of the absence of the tip.

Here both tables agree and show the same, though Table IV most clearly, namely, that the outermost, i. e. the oldest leaf, is the longest throughout the autumn and winter, whereas in mid-summer the second, the third, fourth or even the fifth outermost leaf is the longest; this is in good accordance with what we have learnt from Table II.

Table IV.

Channel off Holckenhavn.

Soft bottom, $2\frac{1}{2}$ — $3\frac{1}{2}$ fathoms.

The length of all the leaves of some plants (in cm.);
each line corresponds to one plant.

1901—02	Outermost — innermost leaf.
18—IX.	— 200 143 108 80 23 185 155 108 80 48 5 155 120 80 65 40 10 165 150 95 78 50 15
15—X.	— 198 143 135 95 25 163 138 110 115 60 18 — 175 130 133 98 25 165 130 105 108 60 13
14 XI.	105 — 85 75 20 105 93 88 45 93 70 45 33 10 85 58 65 45 25 153 123 100 60 20 160 120 90 90 68 33 153 113 68 43 25

1901—02	Outermost — innermost leaf.
15—XII.	75 75 60 60 50 40 15 105 98 88 73 45 23 90 80 78 68 45 — 105 98 90 58 25 130 115 105 95 68 28 — 95 — 83 53 23
15 I.	88 88 88 70 55 23 98 98 100 60 28 85 73 — 50 35 15 123 95 98 98 75 40 10 125 113 105 105 83 35 3 148 123 128 — 83 33 3
15—II.	130 118 100 65 38 15 93 80 50 30 8 85 78 55 38 5 63 65 60 58 48 23 73 65 55 45 28 10
19—III.	105 — 50 28 10 100 — 68 35 13 90 78 65 45 25 100 — 70 58 28 13 80 — 73 70 50 23
17—IV.	113 98 65 43 23 8 118 100 — 45 23 8 138 — 93 58 30 12 113 90 — 75 43 23 78 78 80 65 35 18
15 V.	77 80 82 71 42 — 53 60 60 42 12 49 42 40 52 64 56 37 53 — — 75 75 60 32
15—VI.	76 71 85 93 104 90 52 — 53 64 79 86 77 40 — 97 127 160 170 145 90 113 — 127 140 152 130 85 92 95 — 124 130 106 54 72 84 94 107 117 103 64 70 80 100 — 138 94 44
15 VII.	— 115 132 185 215 190 110 87 106 116 125 — 45 103 126 — 160 135 55 113 — 185 — 175 108 — 160 195 60 72 — — 190 165 68
15—VIII.	124 137 155 147 107 32 151 195 215 200 137 35 170 215 240 210 155 43 — 166 170 167 112 30 155 172 — 190 170 80 165 170 170 135 60 205 220 245 230 160 48 — — 230 210 132 18 180 220 — 230 220 107

The essential points are best seen in Table IV: in September and October the long summer leaves are the outermost leaves; in November the outermost and longest leaf is considerably shorter; at this time the summer leaves have been thrown off. This is the state of the plant till in the month of April; but in May it begins to be altered, as can be seen nicely and regularly in June especially, when in all 7 plants measured the fifth leaf is the longest; then the longest leaf moves further out, yet even in August it is the second or third outermost and not until September is it the very outermost.

The question is now, whether by means of these tables it is possible to draw a conclusion as to the number of leaves produced by the grass-wrack in the course of a year, and in this respect the answer is not very favourable. It must be remembered that only the outer leaves are full-grown, as is most clearly seen when measured, only these having long sheaths. The fact is that the sheath is the part of the leaf which is latest in completing its growth. Taking e. g. the 5 specimens whose lengths of leaves have been entered on February 15th 1902, we have the following measurements:

Length of leaves with sheaths.	Length of corresponding sheaths.
130 118 100 65 38 15	30 28 20 13 0 ¹⁾ 0
93 80 50 30 8	20 15 8 0 0
85 78 55 38 5	20 15 10 0 0
63 65 60 58 48 23	18 18 18 13 3 0
73 65 55 45 28 10	19 15 12 7 0 0

Similarly also on June 15th 1902:

Length of leaves with sheaths.	Length of corresponding sheaths.
76 71 85 93 104 90 52	21 22 20 25 25 3 0
— 53 64 79 86 77 40	— 16 19 22 18 1 0
— 97 127 160 170 145 90	25 29 33 44 25 2 0

To judge from the length of the sheath in the first example, scarcely more than 2—3 leaves have finished their growth in length, in the last example 4 or perhaps 5 have. On this is founded the opinion above stated, that each shoot has at a certain time only 3—6, most often 4—5, full-grown leaves.

As it is thus impossible to make sure that the leaves on the inner side of the longest leaf are full-grown, one cannot draw any conclusion as to their length being final. I do not think therefore that by means of the tables it is possible to decide the exact yearly number of leaves on one shoot. Taking for granted that the growth during the winter half-year (November—April) is extremely small, I venture however to express the supposition that the grass-wrack yearly produces 4 to 6 new leaves on each shoot. It is seen that the place of the longest leaf on the table changes according to the time of the year and it seems to me that this fact lends some countenance to the supposition. The production of leaves is of course rather variable according to the nature of the place, for under favourable conditions the growth is more considerable and possibly more leaves are developed than under bad conditions.

The place near Nyborg gives an example of the *Zostera* vegetation in fjords, where we find the most perfect development of this plant. From the following

¹⁾ The sheath is yet quite undeveloped.

Table V it appears that at the end of July and the beginning of August 1901 the longest leaf was not generally the outermost leaf throughout Danish waters, thus justifying the generalization of the results we have come to from the measurements of the Nyborg material concerning the growth of the grass-wrack.

Table V.**Length of *Zostera* leaves from different Danish waters.**

The length of all the leaves is given in cm; each line corresponds to one plant.

Place, depth, nature of bottom and date.	Measurements in cm.
Livø Bredning, $3\frac{1}{2}$ —3 fm. Soft bottom. $^{27}_{/7}$ OL.	100 — 110 100 50 3 — — 90 93 75 20
Nisum Bredning, Hvidbjærg church in E. by N. $2\frac{1}{2}$ fm. Sand bottom. $^{29}_{/17}$.	— 58 73 75 70 25 60 78 83 83 68 20 50 65 78 — 48 5
Nisum Bredning, E of Stenodden. $2\frac{1}{2}$ fm. Hard bottom. $^{29}_{/7}$.	105 — — 160 165 — 20 — 100 — 108 110 — 40
Livø Bredning. E. of Livø Teglværk. $2\frac{1}{2}$ —2 fm. Soft bottom. $^{30}_{/7}$.	140 — 225 233 210 180 115 33 — — 213 203 193 148 65 5 — — 215 215 190 160 100 25 165 200 208 — 188 135 70 8
Kattegat. Treaa Mølle in S. $4\frac{1}{2}$ fm. Sand bottom. $^{24}_{/7}$.	50 — 78 83 83 60 60 — 50 65 78 85 70 30
Kattegat. A little N. of Mark on Østre Flak, South of Læsø. 6— $4\frac{1}{2}$ fm. Hard bottom. $^{26}_{/7}$.	20 28 35 45 48 35 3 28 35 43 55 65 50 13 33 40 55 63 53 18
Kattegat. Muldbjærg in W.S.W. Jydske Aas in N.W. $\frac{1}{2}$ N. $4\frac{1}{2}$ fm. Sand bottom. $^{26}_{/7}$.	50 78 93 105 100 65 10 65 85 103 93 60 8 43 53 75 83 65 18
Kattegat. Als church in W.S.W. $9\frac{1}{2}$ miles. $5\frac{1}{2}$ fm. Sand bottom. $^{31}_{/7}$.	55 63 70 73 75 55 20 50 65 78 85 80 60 28 55 65 70 70 65 48 15 60 65 68 65 53 30 3
Kattegat. Middle of Gjerrild Bugt. 4 fm. Sand bottom. $^{31}_{/7}$.	35 45 60 70 75 45 8 35 45 43 60 60 40 10 40 53 — 85 93 63 18
North coast of Zealand. Off Hornbæk. 4 fm. Hard bottom $^{22}_{/7}$.	— 63 80 100 115 65 43 68 — 123 123 55 78 83 100 110 93 43
North coast of Zealand. Nekselø Bay. $3\frac{1}{2}$ fm. Soft bottom. $^{23}_{/7}$.	85 110 — 143 130 60 — 113 115 120 115 73 — 108 140 150 130 53 87 — 120 130 125 75
Samsø Belt. Off Udsager Hage. 5— $4\frac{1}{2}$ fm. Hard bottom. $^{1}_{/8}$.	30 43 55 68 75 53 15 30 35 38 40 35 13 45 58 — 70 60 25
Samsø Belt. North of Ballen. $5\frac{1}{2}$ fm. Stony bottom. $^{1}_{/8}$.	38 65 93 105 113 70 10 35 — — 118 135 125 60 43 73 — 118 123 70
Langelands Belt. Off Hou. $4\frac{1}{2}$ —2 fm. Hard bottom. $^{2}_{/8}$.	35 50 78 105 135 133 58 — 73 93 108 125 103 30 — 30 45 75 85 93 50 45 50 60 70 78 63 13 50 63 83 95 105 93 25 55 73 85 93 100 73 18

Place, depth, nature of bottom and date.	Measurements in cm.
Smaaland Waters. Vene Grunden. 4 fm. Hard bottom. $\frac{7}{8}$.	60 70 78 83 68 40 70 70 75 73 73 50 53 55 63 73 65 30
Smaaland Waters. Off Knudsy. 3 fm. Hard bottom. $\frac{7}{8}$.	— 55 53 55 60 45 — 58 60 60 68 45 — 68 73 70 80 70 18 55 65 68 75 65 15 — 63 60 65 58 15
Bøgestrom. N. of Nordre Knigge. $1\frac{1}{2}$ fm. Soft bottom. $\frac{6}{8}$.	— — 95 98 90 48 — 105 — 83 55 13 93 — 95 88 43 70 75 73 70 33

The *Zostera* propagates partly by branching as above mentioned, the branches breaking loose and forming independent shoots, and partly by seed. We are thus led into a discussion of the flower-bearing shoots of the plant. The fact is that the grass-wrack is a real phanerogamous plant related to some of our land plants and freshwater weeds, and has nothing to do with the numerous different kinds of sea-weed (*Fucus*, etc.), which otherwise form the vegetation of Danish waters. Besides the eel-grass, there is in more brackish parts of Danish waters some few other marine phanerogamous plants which will be briefly mentioned later in this paper; but none of them are of any importance to the biology of the sea.

The flower-bearing shoots of the grass-wrack (Figs. 2 and 3) are put forth in early summer; the first faint indications of them are seen in April—May, but only later in the summer do they reach their full development. It is the tip of the creeping root-stock which develops into a flower-bearing shoot; the inter-nodes suddenly grow longer and grow upwards; no roots develop at the nodes; the almost terete stem becomes flattened and the leaves become shorter. Then an ample ramification takes place on two sides, giving the whole flower-bearing shoot a fan-like appearance. Each branch ends in an inflorescence of a peculiar shape. It looks as if the whole shoot only consisted of leaves on whose inner side the middle part is a little swollen. On further investigation a longitudinal fold is visible on this part, within which lies a flat body 4—6 cm. long, on the one surface of which the small flowers are placed. This body is the uppermost part of the shoot and the fissured organ by which it is enclosed is the sheath of the uppermost developed leaf; its blade apparently forms the tip of the shoot. The structure of the flowers of which this remarkable inflorescence is composed is very simple; they consist of two rows: alternately anthers (two oblong-pyriform bodies) and pistils (a club-shaped body, which is fastened at the side and at the pointed end split into two long, filiform appendices, the stigmas). The anthers are the male organs; they contain an enormous quantity of very fine threads (12 mm. long by 0,008 mm. broad)¹⁾ which are freed by the bursting of the anthers and float about in the water. Should they meet the filiform stigmas of the pistils they

¹⁾ *O. Rosenberg*: Ueber die Pollenbildung von *Zostera*, Upsala 1901, S. 16.

fasten on them, and a fertilisation of the female organ, the ovule which is enclosed in the pistil, is effected. The fertilisation is thus brought about by means of the water, a peculiarity only very seldom seen in the phanerogamous plants. In conformity with this the pollen of the anthers is shaped like fine threads, whereas in the planerogamous plants it generally consists of small round grains. The anthers of one inflorescence of the *Zostera* cannot fertilize the pistils of the same inflorescence, as the latter develop first and the time within which they are receptive of fertilisation is over when the anthers open; it is thus evident that fertilisation must be effected by pollen from other inflorescences, one stage ahead in development. Fertilisation having been effected, the pistil gradually swells and inside it one single seed develops, which when ripe is ca. 3 mm. by 1.5 mm., cylindrical in shape with rounded ends and of a gray-brown or yellow-brown tinge; the shell of the seed has faint longitudinal stripes. When the seed is ripe the pericarp opens by a longitudinal fissure, so that the seed may slip out; the pericarp itself is rather thin, juicy and soft.

The freed seeds sink to the bottom of the water (or they are perhaps sometimes swallowed by fishes, through the alimentary tract of which they pass undigested). The current carries them away to other places where they form new growths of eel-grass. The germination probably takes place in the following spring; I have at any rate found seedlings in July—August which were probably not a year old, as they had not yet put forth any visible creeping shoot. These young seedlings are however only very seldom to be seen, mostly due to the fact that they do not generally come loose together with the larger shoots of the eel-grass when these are torn from the bottom, and a direct investigation of the place where the *Zostera* is growing, for the purpose of ascertaining the number of the seedlings, is rather difficult to effect.

The different vegetations of *Zostera* show a great difference in regard to the number of the flower-bearing shoots; at some places one finds them in quantities, at other places one cannot find a single specimen for long distances. In all probability the number varies also year by year.

The flowering begins in June and is continued during the summer, the flower-bearing shoots constantly producing new inflorescences. On investigating such a shoot in mid-summer inflorescences in all stages of development are therefore found. I have found the first ripe fruits in the first week of August or thereabouts. The inflorescences which develop last seldom or never have ripe fruit, partly because the fecundation probably fails and partly because the whole flower-bearing shoot is thrown off or broken later in the autumn, at the time when the large quantity of leaves is thrown off. It is thus seen that the flower-bearing shoots only remain in existence for some months (4—5).

I am not able to state what is the cause of the abundance of flowers; I have come across good fruit-bearing shoots in calm fjords on soft bottom as well as in the open Kattegat on hard bottom; nor does the depth seem to be of any consequence.

III. The outer conditions for the growth of the *Zostera*.

The grass-wrack is a pronounced aquatic plant which can only grow when surrounded by water and withers if exposed to the air for any length of time; thus, its growth ceases at the lowest water mark. The presence of water is not sufficient however, the water must also be saline. We can best notice how the fresh water hinders the growth of the *Zostera* at the mouth of larger streams, for example, the outlet of the river Gudenaa in Randers Fjord, where the eel-grass is only to be found a short way up beyond Udbyhøj. The ability of the eel-grass to grow in salt water is a peculiarity it has in common with only a few other flowering plants and no other northern flowering plant has it to such a pronounced extent. The *Zostera nana* Roth, which occurs frequently on our coasts as low, small growths in quite shallow water, comes close to the common eel-grass in this regard. The few other marine flowering plants which grow in our waters live in more brackish water.

The eel-grass also grows on those of our coasts where the salinity of the water is highest (about 3.3 per cent.), namely, along the west coast of Jutland and on the inner side of the north point of Jutland; it is not common nor does it grow extensively at these places, but this is due to other factors than the salinity. The latter decreases up through the Kattegat and the Belts, and on the east coast of Falster and in Faxe Bay it is as low as 1.0 per cent., but we still find the eel-grass there. Its distribution extends still further up the Baltic, where its most northern occurrence seems to be in the Åland Sea (according to *R. Sernander*, *Botaniska Notiser*, Lund, 1901, p. 276). Here the salinity is not more than about 0.6 per cent.

We see from this that the grass-wrack certainly requires salt water, but we find also that it is not very particular about the degree of salinity. A salinity of 1 to 3 per cent. may be considered the most advantageous for its growth, and as it is just between these limits that the salinity in our Danish Seas varies, we cannot wonder that the eel-grass is at home with us.

A fairly sheltered locality is another condition for the success of the eel-grass. It cannot grow on an open coast where the waves beat heavily and the motion is felt a good way down in the water; the bottom at such places is either too unsteady for the roots to fasten themselves on, or too stony with consequently

no opportunity for growth for our plant, which does not possess the ability of the algæ to fix themselves on stony ground. Along the open west coast of Jutland the bottom is therefore nearly devoid of *Zostera*; but wherever there is some shelter we immediately find the grass wrack again, e. g. between Fanø and the mainland as well as beyond the political boundaries of Denmark along the island-rich west coast of Schleswig. We may however seek for places with richer growths in our own waters within the Skaw, and we find these already in Aalbæk Bay and further on wherever the conditions are suitable for the plant.

We come now to a third condition for the growth of the grass-wrack, that is, the light. All green plants (also the blue-green, the brown and the red) require light to be able to thrive. The light is as a matter of fact a necessary source of power to them, because by its means and by means of their own green pigment they produce new stuffs for their growth from the carbonic acid of the air or water. In this way they develop the organic substances from the inorganic and this wonderful ability is the fundamental basis for all life on earth. The difference between the distribution of plant life on the land and in the sea arises from the dependence of the plants on light. While the land is covered with plants, the low-lying parts as well as the high, except where perpetual snow covers the ground or the scarcity of water hinders the growth of the plants, all plant life in the sea (save that of the bacteria) ceases at the depth of about 200 meters. The sea-bed lying deeper than this is only inhabited by animals and bacteria; the reason for this is that the light can only penetrate downwards to a certain depth and below this an impenetrable darkness reigns, only lighted up now and then by the flash from various marine animals with light-producing organs. The different components of white light penetrate to different degrees down into the water, the amount of refraction and absorption being different; the green, blue and ultraviolet components go furthest down and in connection with this we find that the red-coloured plants, which just absorb these components, are to be found deepest down. On the other hand, the brown and especially the green plants cannot grow so deep down, from which we may conclude that the eel-grass cannot grow at any great depth. The more definite question: how far down can it grow, cannot be answered from this side, it must be answered from direct investigations. The result of my observations in Danish waters is that the eel-grass goes much deeper down at some places than at others, and that this is connected with the clearness (transparency) of the water. At the time of year, in summer, when I made my observations, the water has as a rule its lowest transparency, as it then contains the most plankton. But this rule does not hold in all cases, and besides, other factors are present here; thus, the water near the coast is always less transparent during or after a storm or fall of rain than it is on calm days (comp. the observation from Fæmø Sound on next page). To obtain however some standard for the transparency of the water, a standard which, if not absolute, could yet give comparable data, I employed a disc painted white, 20 by 15 cm. It was let down into the water fixed to the lead-line. It proved that under fairly quiet conditions the disc could be seen nearly at the same depth as that to which the *Zostera* reaches, as the following observations show:

Lim Fjord, east of Livø brickfield (³⁰/₇ 1901). Soft ground. No *Zostera*

to be found at a depth of 3 fathoms, but at $2\frac{1}{2}$ —2 fathoms an abundance of long broad-leaved *Zostera*. The white disc could be seen faintly at a depth of 2 fathoms.

Kattegat. Als Church in W.S.W. $9\frac{1}{2}$ miles ($\frac{31}{7}$). Pure sand bottom. At $5\frac{1}{2}$ fathoms a small quantity of narrow-leaved *Zostera*. The disc could be seen to a little more than 5 fathoms.

Langeland Belt. Off Hou ($\frac{1}{8}$). Firm (stony) bottom. At 5 fathoms scattered *Zostera*, from $4\frac{1}{2}$ fathoms and inwards plenty of *Zostera*. The disc could be seen at ca. 5 fathoms.

Fæmø Sound ($\frac{2}{8}$). Soft ground. At 4 fathoms no *Zostera*. At 3—2 fathoms plenty of *Zostera*. The disc could only be seen at ca. 1 fathom owing to rough sea.

Guldborgsund. Flinthorn Reef in N.N.E. ($\frac{5}{8}$). Soft ground. At $3\frac{1}{2}$ fathoms no *Zostera*. From 3 fathoms plenty of *Zostera*. The white disc could only be seen scarcely to 3 fathoms although the water seemed to be clean and transparent.

Baltic. Off Falster. Viggerløse Church in N.W. to W. $\frac{1}{2}$ W. $5\frac{1}{2}$ miles ($\frac{5}{8}$). Pure sand bottom at 6 fathoms. The white disc could be seen at 4 fathoms (in the neighbourhood at Tromnæs the *Zostera* grows down to a depth of almost $5\frac{1}{2}$ fathoms).

Baltic. In the centre of Faxe Bay ($\frac{6}{8}$). Pure sand bottom at 6 fathoms. The white disc to be seen at $4\frac{1}{2}$ fathoms. (Off Faxe the *Zostera* grows down to quite 4 fathoms).

(For the rest, see the observation material (Chap. IX) at the end of the paper.)

We may conclude from these observations that the grass wrack grows as far down in the water as all the components of the sunlight reach; they are a little weakened in quantity but unchanged in quality.

As a general rule, the grass-wrack goes deepest down in the open waters, where the water is most transparent, and to a less depth in the muddy waters of the fjords. The actual data are stated in the observation material at the end of the paper (p. 47); but the following may be taken as the general results for our different waters:

In the Lim Fjord the limit is about	3 fathoms	(ca. 5.5 m.),
- — Kattegat (Aalborg Bay) nearly	6	— (ca. 11.0 -),
- — Great Belt and Langeland Belt about ...	$5\frac{1}{2}$	— (ca. 10.4 -),
- — Little Belt about	$4\frac{1}{2}$	— (ca. 8.5 -),
Waters between Samsø and Jutland about	5	— (ca. 9.5 -),
Smaaland Waters (open part) about	$4\frac{1}{2}$	— (ca. 8.5 -),
The Sound and north coast of Zealand about ..	$4\frac{1}{2}$ —5	fathoms (ca. 8.5—9.5 m.),
Baltic (Faxe Bay) about	4	fathoms (ca. 7.5 m.),
Baltic (off Falster) about	$5\frac{1}{2}$	— (ca. 10.4 -).

The smaller sounds and bays are very similar to the Lim Fjord, so that the depth limit is about 3 fathoms (ca. 5.5 m.), e. g. Guldborgsund and Fæmø Sound; in Bøgestrøm even as low as 2 fathoms.

Thus the depth limit varies between nearly 6 fathoms (ca. 11 m.) in the most transparent water and 2—3 fathoms (ca. 4—5.5 m.) in the less transparent though still flowing water of the fjords. The extreme limit, ca. 6 fathoms, is a

little lower than that earlier given for our waters. Thus, C. G. Joh. Petersen gives for the Kattegat 6—7 fathoms¹⁾ and for the Little Belt 4—5 even 6 fathoms²⁾. J. Reinke³⁾ states that he found grass-wrack in the western part of the Baltic, »vereinzelte bis zu 17 Meter Tiefe« on sand bottom, and E. Warming (Dansk Plantevækst I, Strandvegetation, p. 185) says that »even as much as 10—14 m. is given for the Kattegat and the Little Belt«. I think however, I may suggest that these reports rest upon the inaccuracy of the soundings; most of them come from observations made for zoological or fisheries purposes, and for these one fathom more or less is quite immaterial. In the Kattegat (the place where all consider that the grass-wrack goes deepest down in our waters) I have made particularly careful observations to fix the limits and have come to the conclusion, that the 6 fathom curve is never reached nor surpassed by growing *Zostera*; see for the rest the specified data later (observation material, p. 47).

We have statements from other countries that the *Zostera* vegetation grows at greater depths. Thus, Karl Techet⁴⁾ states for Trieste Golf that it grows at a depth of 17—18 meters, and it is very probable that it grows deeper down in the clear water of the Mediterranean than in our own less transparent waters.

J. Reinke (l. c.) remarks that the grass-wrack goes deeper down on a sandy than on a muddy bottom and this agrees with my own experience. The explanation is most likely simply this, that the water over sandy bottom is clearer (more transparent) than over muddy soil, where fairly large quantities of mud particles are always being stirred up into the water.

The nature of the bottom soil is an important factor in many regards for the *Zostera*'s growth. It has already been mentioned that the plant must have loose (not rocky) soil for the roots to fix themselves on, but the varying consistency of the loose bottom is also of importance and affects the growth and appearance of our plant. The extreme kinds of bottom soil in which the grass-wrack grows are on the one hand the firm sand, sometimes covered with stones and on the other the soft, muddy bottom of the quiet bays and fjords. It is found on both sorts of ground, but the plant we find on the firm, sandy bottom is certainly in many ways different from what I call the Mud-*Zostera*. We may examine into this a little more closely.

In the open waters where the motion of the waves is felt a good way down, the bottom is firm and sandy to a considerable depth; there is no rest to permit of the formation of the soft kind of soil generally called mud, which is characterized by its abundance of organic matters (decayed pieces of plants and animals) as well as by its fine clay particles. If we choose the Kattegat as a typical example of an open water — and in this connection it must be counted as one, because the occurrence of the grass-wrack depends on a certain even if but small amount

¹⁾ C. G. Joh. Petersen: Det videnskabelige Udbytte af Kanonbaaden Hauchs Togter, 1893, p. 437, and Beretning IX fra den danske Biologiske Station, 1900, p. 32.

²⁾ C. G. Joh. Petersen, Beretning III fra den danske Biologiske Station 1893, p. 28.

³⁾ J. Reinke, Algenflora der westlichen Ostsee deutschen Anteils, 1889, p. 12.

⁴⁾ Ueber die Marine Vegetation des Triester Golfes. — Abhandl. der k. k. zool.-botan. Gesellsch. in Wien, III. 3. 1906. p. 17.

of protection (see p. 17) — we find¹⁾ that the pure firm sand reaches a depth of about 7 fathoms, after which follows a »mixed« soil, which again passes over into the pure clay bottom (ooze) at a depth of about 20 fathoms. It is thus only the pure sand bottom which comes into consideration for the grass-wrack, and it grows on this in scattered places in the part of the Kattegat which is generally called Aalborg Bay, namely, the shallow water bounded to the north by Læsø, to the west and south-west by the east coast of Jutland (Djursland), and to the south-east by Anholt; and it forms further an almost unbroken border along the coast from $\frac{1}{2}$ —1 fathoms depth and to a depth of 5—6 fathoms. It is more rare in quite shallow water, possibly because the waves beat too heavily there, for we find it immediately there is any protection or shelter. C. G. Joh. Petersen and I. Chr. L. Levinsen (Beretning fra den danske Biologiske Station IX, 1900, p. 32) say regarding the northern part of the Kattegat: »The *Zostera* is able to take root already at a depth of 1 fathom«; the upper limit is thus placed here at a depth of 1 fathom.

The grass-wrack found on firm sand like this has the same appearance, whether it grows at a depth of 1 fathom or of nearly 6 fathoms. The leaves are comparatively short and narrow, the creeping root-stock is strong, with often rather long internodes; the flowering shoots can be seen now and then, although not as often as in the bays.

The accompanying figure is a reduced representation of the Kattegat-*Zostera* and should be compared with the figures (figs. 1 and 6) of Mud-*Zostera*. In the Table of measurements (pp. 41—45) are given the length of the leaves, the length of the sheaths, the breadth of the leaves and the length of the flowering shoots. It is evident from these that the length of the leaves only rarely reaches 100 cm., and the breadth varies between 3 and 5 mm.; the flowering shoots on the other hand may reach quite 150 cm.

The grass-wrack on the firm bottom in the open Baltic has quite



Fig. 3. Leaf-bearing (A) and flower-bearing (B) shoots of the Kattegat-*Zostera*.

(Firm, sandy bottom; Ostre Flak, S. of Læsø, 5 fm. 26. VII. 01).

¹⁾ Beretning fra den danske Biologiske Station IX, 1900.

the same appearance, a conclusion I draw from the observations made off the east coast of Falster (fig. 4) and in Faxe Bay (see the Table of measurements, p. 46). The length of the leaves is here not above 83 cm. and the breadth between 3 and 4.5 mm.

Along our coasts the grass-wrack does not form large, connected growths neither in the open Kattegat nor in the Baltic; the situation is apparently not very suitable and this may be due to the want of shelter and the poor soil.

As soon as there is a little shelter the grass-wrack appears in large quantities and the single plant grows stronger in all respects. In the Table of measurements (p. 42—46) we find even transitions from the narrow-leaved Kattegat-Zostera to the broad-leaved Mud-Zostera. The Zostera in Nissum Bredning, in Samsø Belt, along the north coast of Zealand and partly in the Smaalands Waters furnishes examples of such intermediate stages, and we nearly always find the bottom given as firm. It is generally a dark-coloured sand bottom soil the colour of which is due to no small quantities of organic materials mixed with sand — in other words, a soil where there is certainly a considerable wave-motion, but yet where

a portion of the organic particles has been deposited and has fertilized the sand. The measurements from Smaalands waters (see Table p. 45) give a fairly clear picture of the Zostera's relation to the kind of bottom soil; the first two stations (1—2) were taken in Fæmø Sound and thereabouts; the soil is here soft and the leaves of the Zostera reach a length of 88—138 cm. and a breadth of 6.5—7 mm.; the other stations were in more open water and have a more solid soil; the length of the leaves is here mostly below 100 cm. and the breadth between 4.5—6 mm. (see fig. 2). The other conditions being very similar, it appears from this that the different growth of the grass-wrack is due to the different bottom soil and the conditions which arise from these.

We find a typical vegetation of Mud-Zostera in Nyborg Bay and the measurements given above (pp. 8—9) of Zostera plants throughout a whole year provide an excellent material for the purpose of elucidating the appearance of the grass-wrack, when it grows on the soil which suits the plant best and where it reaches its highest degree of development.

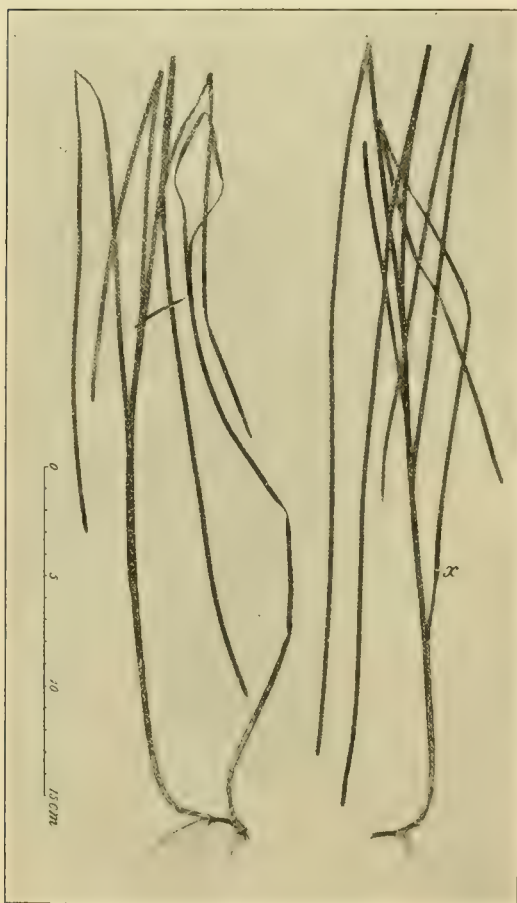


Fig. 4. Two leaf-bearing shoots of the small-leaved Zostera from the Baltic, at *x* the blade is about to separate from the sheath.
(Firm, stony ground, off Tromsø, Falster 51/2 fm., 5. VIII. 01.)

With regard to the sheltered places, it is necessary to distinguish between plants growing in shallow and deeper water, a difference which does not exist in open waters, and the reason for this distinction lies in the nature of the bottom soil. Close under the land we usually find a belt with firm bottom, mostly dark-coloured sand, and the grass-wrack growing on this soil is much like that of the open water; but at $1\frac{1}{2}$ to 2 fathoms and outwards the soil consists of soft mud, and here we meet the true Mud-Zostera. The grass-wrack of the shallow water is

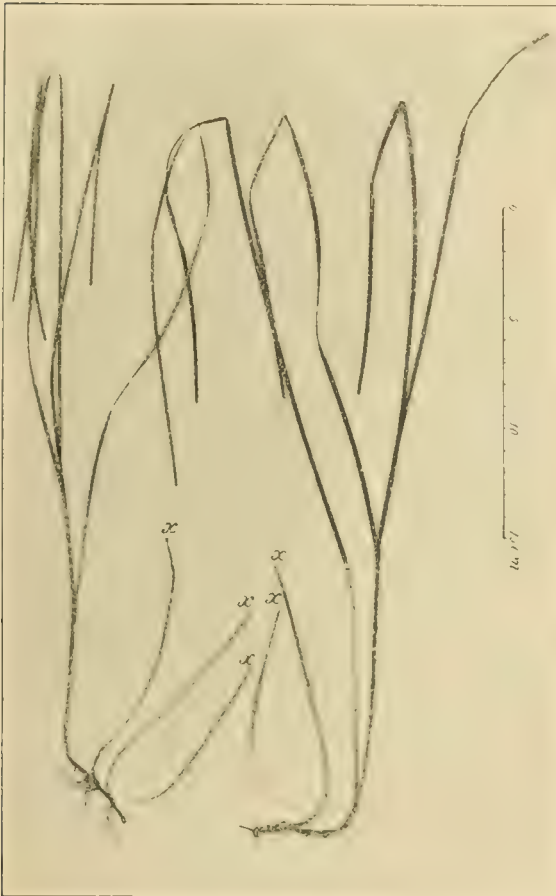


Fig. 5. Small-leaved *Zostera* from shallow water at Holckenhavn near Nyborg; at x the shedding places.
(Firm, sandy bottom, $1\frac{1}{2}$ fm., 9. VIII. 01.)



Fig. 6. Broad-leaved *Zostera* (Mud-Zostera) from deeper water at Holckenhavn near Nyborg; at x the shedding places.
(Soft, muddy ground, $3\frac{1}{4}$ fm., 9. VIII. 01.)

narrow-leaved and short (fig. 5); the length of the leaves varies from 30 to 100 cm. and the breadth from 2.5 to 4.5 mm. (see Table I, p. 8). The true Mud-Zostera (fig. 6) on the other hand reaches a length of ca. 100—240 cm. and a breadth of ca. 5—8 mm. (see Table II p. 9, where for the sake of comparison we should consider the measurements for the late summer, as the observations from other places were made at this time of year).

In the Table of measurements (p. 44) is given a similar series of measure-

ments, made on plants from various depths in a quiet creek in Nexelø Bay on the north coast of Zealand (Table No. 2); it is in sharp contrast to the measurements from the other stations on the north coast of Zealand, for these all come from the open water. Typical Mud-Zostera measurements are further given in the Table for the Lim Fjord, east of Livø brickfield and off Nykjøbing Mors (Limfjord, Nos. 7 and 9), for the waters between Samsø and Jutland (No. 1—2) and off Nysted (Guldborgsund, Nos. 5—6). The leaves of the grass-wrack in Langeland Belt (Great Belt and Langeland Belt, Nos. 2—4) are a little narrower but of the same length, although the bottom soil is mostly firm here; it is however not the ordinary sand bottom but stony with rich algal vegetation, where the fine nutritious material has been able to settle between the stones. This exception is an excellent confirmation of the rule that the length and breadth of the Zostera leaves, i. e. the size of the grass-wrack, is more dependent on the nature of the bottom soil than on the depth in which it grows, though within certain limits, since the plant never grows large and broad-leaved in quite shallow water. K. Techet's statement (l. c., p. 19) as to richer growth of the Zostera in Trieste Golf near the harbour, where of course the sea bottom and the sea water are richer in organic matters than at a further distance off, agrees well with my observations. The Zostera plants are much like land plants in regard to the importance of the nature of the ground, and not so much like most other marine plants, the algæ. We usually find it stated that it is the depth, which is the most important, but this is not quite correct as shown here. It is thus not entirely in accordance with the facts, when P. Magnus¹⁾ states that the leaves of the grass-wrack in the Western Baltic become larger and broader at greater depths, or when E. Warming²⁾ says in his »Strandvegetation«: »The size of the Zostera-leaves is dependent on the depth etc.«; this author adds however a little further on in the same work (p. 192): »The Zostera belt is divisible into two, a broad-leaved and a narrow-leaved kind, connected with the depth and perhaps also with the nature of the bottom soil, as far as this may be firmer in shallower water and less permeable for the roots and root stocks; neither is it perhaps so rich in nutriment«. ³⁾

¹⁾ Ber. d. Komm. zur wissensch. Unters. deutscher Meere in Kiel, 1872—73, p. 66.

²⁾ Dansk Plantevækst. I. Strandvegetation, 1906, p. 185.

³⁾ I am responsible for the translation from the Danish and for the emphasis.

IV. Distribution of the *Zostera* in Danish waters.

The factors discussed in the foregoing for a successful growth of the *Zostera* afford in themselves some basis for judging as to the extent of the distribution of this plant in our waters. They may be summarized in the following statements: The *Zostera* requires an at all events somewhat protected habitat, and thus thrives best in our small waters; its dependence on light has the result, that it can only grow in depths which do not exceed 6 fathoms (ca. 11 meters) and consequently one can only expect to find it as a fringe along the coast, and out on the quite shallow parts of the Kattegat and the Smaaland Waters. As it attains its best growth on pure and sand-mixed muddy bottom, we find the richest *Zostera* vegetation in our fjords.

The following more detailed remarks about its distribution in our waters may further serve to show the correctness of the statements.

Knowledge of the distribution of the *Zostera* in our waters is almost entirely due to the Director of the Biological Station Dr. C. G. Joh. Petersen. Already in the first report of the Biological Station (1891) there is a chart and a thorough discussion of the distributed of the *Zostera* in Holbæk Fjord (Zealand) and its importance to the animal life there. A similar detailed investigation likewise accompanied by a chart of the parts investigated is found in the third report of the Biological Station, dealing with the Little Belt together with Fæø Sound, Gamborg Fjord and Kolding Fjord. At almost the same time (1893) as this report appeared »Det videnskabelige Udbytte af Kanonbaaden Hauch's Togter«, in the text of which (p. 437) some information is given regarding the vegetation of the sea bottom, and the atlas contains a chart (III) of the Kattegat with data on the occurrence of the *Zostera*. In the Report IX (1900) of the Biological Station some notes are given on the distribution of the *Zostera* in the Northern Kattegat, and finally Report X (1901) is accompanied by a chart of our waters, in which the occurrence of the *Zostera* is compared with the position of the eel traps.

The investigation I undertook in 1901 was to supplement these data and consisted in a rapid cruise through most of our waters.

Starting from the consideration that the vegetation, at places which offered the *Zostera* practically the same conditions, would also be very similar, I tried in the three weeks, in which the expedition lasted, to find an opportunity by

personal observation of procuring a survey of the conditions of the vegetation at the most possible and varied places. A short statement of the route of »Sallingsund« will show this. We began by examining the Sound from Copenhagen and northward, then followed the north coast of Zealand, further along the south coast of Samsø to Ashoved, from there to the north along the coast of Jutland to Aarhus, into Kaløvig and round Sletterhage and Hasenøre, along the coast of Djursland to Udbyhøj in Randers Fjord, and thence northward into the Kattegat to Østre-Knold and Østre-Flak. We then went in through the Lim Fjord to Nykøbing and further through Sallingsund to Nissum Bredning which was pretty closely examined before we returned the same way to Hals; across the Kattegat (with various stations) to Stavns Fjord in Samsø; along the east coast of Samsø, and through the Great Belt on the Funen and Langeland side. After a visit to Nakskov Fjord we proceeded north of Lolland, through Guldborgsund and up along the east coast of Falster through Grønsund and the Bøgestrøm to Masnedsund, through the Smaalund Waters and further south of Omø through the Great Belt to Nyborg, where the expedition ended.

The points investigated everywhere were: 1) if there was *Zostera*, 2) how far out the vegetation reached, 3) on what kind of bottom it was found, and 4) how the *Zostera* was developed with regard to the length and breadth of the leaves, flowering shoots etc. A dredge formed by providing a lead with long nails, was most often used for the investigations; but where the bottom was specially firm it was found necessary to use a dredge with teeth (oyster dredge).

The results of the single dredgings and hauls are given at the end of this paper, and there the data are also added of the occurrence of the *Zostera* as given in the Journals of the Biological Station which Dr. Petersen has placed at my disposal. I may therefore with regard to the details refer to this material (observation material p. 47), which is arranged in groups according to the waters. A synoptic view of the distribution in the single waters may be given here, illustrated by charts with respect to the Lim Fjord and the Kattegat. For the rest I may especially refer to the above-mentioned excellent chart in Report X of the Biological Station.

1. The west coast of Jutland. Here scarcely any investigations were made. I am only acquainted with the *Zostera* vegetation from the waters between Fanø and the mainland (at Esbjerg) and from Ho Bay. As far as known, the *Zostera* is wanting all along the open coast from Horns Reef and to Skagen; it is at all events certain that if the plant occurs anywhere on this tract, it is only at single scattered spots.

2. The Lim Fjord (fig. 7). A coastal fringe of *Zostera* is found in all the many estuaries (Brednings) and sounds of the Lim Fjord, but the vegetation does not go deeper out than ca. 3 fathoms; at the most exposed places in Nissum Bredning (and also elsewhere in the western Lim Fjord), for example, off the Helligsø brickfield and the Ramstrup hills, the vegetation is poor or is wanting here and there; Nissum Bredning is on the whole least covered, and the abundance and richness of the vegetation increase towards the east, and also in the

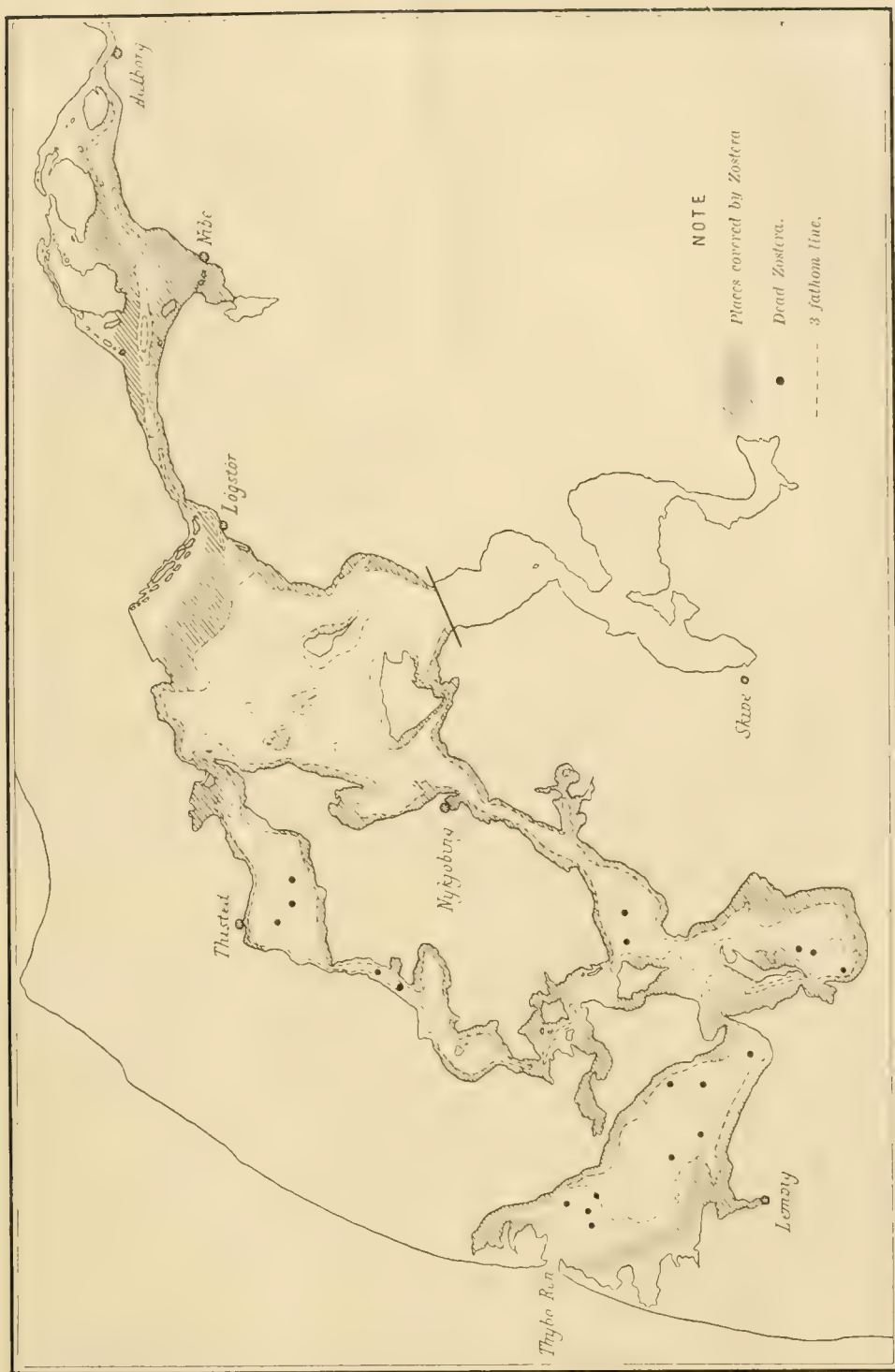


Fig 7. Chart of the Lim Fjord from Aalborg and westward. The part south of the line on the south side of Liva Bredning (Skivefjord, Lovnsfjord, Hjarbak Fjord) was not investigated.

larger bays; thus it is very rich in Venø Bay and in the part from Logstør to Aalborg.

At most of the places in the Lim Fjord the *Zostera* is long and broad-leaved, which agrees with the generally rich (mud-mixed) bottom, and which is further supported by the fact that the *Zostera* in Nissum Bredning, where the bottom is sandier and firmer, is shorter and narrower leaved.

3. Kattegat (fig. 8). Along the east coast of Jutland from Skagen to Mols (Hasenøre) there is a narrower or broader belt of fairly delicate and narrow-leaved *Zostera* out to a depth of about 6 fathoms, at some places, however, little developed and on the other hand sometimes (e. g. at Asaa and at similar protected places) replaced by a vigorous and broad-leaved one. The belt is broadest between Hals and Djursland, that is, in Aalborg Bay; here the *Zostera* in small patches reaches much further out; there is even a connection by patches from the vegetation on the coast to the extensive *Zostera* meadows on the Læsø south grounds.

In spite of its wide distribution in the Kattegat the grass-wrack is of but small practical importance there, on account of its scattered mode of occurrence and its feeble growth; from this however we must again except the Læsø south grounds.

4. The waters between Jutland and Samsø including Aarhus Bay. We have now got to more protected waters and at once find a more abundant *Zostera* vegetation. In Kalø as well as in Æbeltoft Vig there is a thick vegetation of *Zostera* down to a depth of 5 fathoms; but off the points the vegetation is as elsewhere, poor. Along the east coast of Jutland, from Aarhus and southward to Endelave the vegetation of large and broad-leaved *Zostera* spreads more and more, so that it fills, to the south, almost the whole water between Gyllingnæs and Endelave. Here we find the first large area with Mud-*Zostera*, namely between Tunø, the Svanegrund and Endelave to the east and the coast of Jutland to the west.

5. Little Belt. Concerning the Little Belt I may refer to Dr. Petersen's Chart in Report III of the Biological Station. The east Jutland fjords are all greatly covered with *Zostera*; a poorer vegetation is found between Funen and Æbelø and also along the coast of Baaring Vig. South of the area charted by Dr. Petersen, the vegetation along the coast of Funen as along the coast of Schleswig¹⁾ is rich and well developed. And in the island-rich waters south of Funen we have one of the large areas for the occurrence of the *Zostera*; I have unfortunately but little exact information from there. I can only say that my general impression agrees with Dr. Petersen's chart, which shows a very wide distribution of the *Zostera* in these parts.

6. Odense Fjord. Copious and vigorous *Zostera* vegetation to 3—4 fathoms depth; especially in Midskov Bay.

7. Samsø Belt. There is a fairly copious vegetation in Stavns Fjord,

¹⁾ According to J. Reinke's atlas (see above).



Fig. 8. Chart over the western part of the Kattegat.

but for the rest only a narrow fringe along the east coast of Samsø. It reaches down to $5-5\frac{1}{2}$ fathoms depth. The *Zostera* is fairly long and vigorous, but grows scattered (mixed vegetation).

8. Great Belt and Langeland Belt. A similar vegetation as in Samsø Belt is found along the coasts of Funen and Langeland. The *Zostera* is long and vigorous, but grows scattered and mixed with a great many algæ which are mostly fixed to small stones, found on the bottom there. Where there are bays and fjords the occurrence of the *Zostera* vegetation becomes broader, as between Funen and Romsø, in Kjertermind Bay, between Funen and Langeland (Lunge Bay); it is here the large vigorous *Zostera* which occurs. To the south we again reach the just-mentioned extensive vegetation between the small islands south of Funen.

The *Zostera* reaches down to a depth of $5-5\frac{1}{2}$ fathoms in the open Belt, and to $4-4\frac{1}{2}$ fathoms in the bays.

I am but little acquainted with the conditions on the Zealand side, but what I know agrees with those mentioned for the western side. Rich vegetation is thus found e. g. in Kallundborg Fjord and Musholm Bay and in Albu Fjord.

9. The north coast of Zealand. The open north coast of Zealand does not offer favourable conditions for *Zostera*, and it is also but a sparse and scattered vegetation we find here in the narrow coastal margin to ca. 5 fathoms depth. The *Zostera* is fairly delicate and narrow-leaved, and generally occurs scattered among the algæ; the bottom is firm, sandy or stony. These are the conditions from Refsnæs to Vrøj, round Sejerø, and from Zealand Odde to the Sound; the *Zostera* is even at many places wanting altogether, especially on this last extensive tract.

In Nexelø Bay however we find a rich and abundant vegetation on soft bottom from $4-2\frac{1}{2}$ fathoms (see p. 24).

10. Isse Fjord. Concerning Holbæk Fjord reference may be made to Report I of the Biological Station. The widely distributed, dense vegetation of abundant Mud-*Zostera* reaches out to $2-2\frac{1}{2}$ fathoms depth. Similar conditions occur in the other bays of the Isse Fjord while the Isse Fjord itself is only covered on a narrow strip along the coast.

11. The Sound. In the northern half of the Sound from Elsinore to Drogden, good *Zostera* vegetation occurs from the coast to about $4\frac{1}{2}$ fathoms, at many places, however, with bare spots or greatly mixed with algæ. The best vegetation is in about 3 fathoms. The *Zostera* is long and broad-leaved at most places, as usually less vigorous close under land and at sandy places, e. g. in Nivaa Bay and off Rungsted.

More to the south, in Køge Bay, the vegetation is of less importance.

12. The Smaaland Waters. In the waters between the south coast of Zealand and Lolland-Falster the most widely distributed *Zostera* vegetation in our waters is found. It attains its most luxuriant development in the island-rich, shallow waters north of Lolland (Fæmø Sound, etc.), where the large vigorous

Mud-Zostera covers most of the sea bottom, only, however, to a depth of quite 3 fathoms.

In the more open parts of the Smaaland Waters the Zostera reaches much deeper down, e. g. at Omø to ca. 5 fathoms and at Kirkegrund and Venegrund to ca. $4\frac{1}{2}$ fathoms; the deeper parts are on the contrary devoid of »grass«. The plants are here somewhat narrower in the leaves and on the whole more delicate than amongst the small islands.

13. Guldborgsund. Through Guldborgsund runs a partly artificially maintained fairway, the bottom of which (the depth is 3 fathoms or more) is bare muddy bottom; but apart from this passage, the bottom of the sound is everywhere covered by Mud-Zostera; thick and vigorous vegetations on soft bottom from 3 à $2\frac{1}{2}$ fathoms and less; and on the dark (mud-mixed) sand of the shallow waters more scattered, short and narrow-leaved plants, amongst which *Ruppia*, *Zannichellia* and *Potamogeton pectinatus* occur as a frequent intermixture. Amongst the plants, like moss in meadows, grow *Chara* and *Tolypella* and other algæ (*Cladophora rupestris*, *Furcellaria* etc.).

As the sound is widest to the south, the tract covered becomes greatest there.

Almost the same conditions occur in the closed water south of Nysted, bounded towards the open Baltic by the Rødsand barrier; the shallow water (to quite 1 fathom) is however here sparsely covered, generally bare sandy bottom with scattered Zostera patches; on the other hand from $1\frac{1}{2}$ to $2\frac{3}{4}$ fathoms there is soft ground with vigorous Mud-Zostera with »moss« at the bottom.

14. Grønsund, Ulvsund and the Bøgestrøm. In the whole part between Zealand on the one side, Møen, Falster and the small islands on the other, and among the islands themselves, the kind of vegetation is almost as in Guldborgsund; there is however some difference on the southern open part of Grønsund and the Storstrøm at Masnedø as one division, and the other tract as another, as the two mentioned sounds are less protected than the others and consequently with less abundant Zostera vegetation. The Zostera does not generally reach deeper than 2 fathoms, and if the bottom, on account of the action of the waves, is firm and sandy at this depth, the Zostera vegetation will also be small, consisting of fairly short and narrow-leaved plants in patches. At more protected places, especially in the whole of the Bøgestrøm, the bottom is on the other hand still soft at a depth of from 2 to almost 1 fathom and here we find widely distributed Zostera vegetation with large and broad-leaved plants, mixed with the other marine flowering plants and *Chara*. In shallower water the bottom becomes mixed with sand in the same way as in Guldborgsund.

15. The Baltic. From the open Baltic I have only observations from south of Rødsand (Lolland), from the south and east coast of Falster and from Faxe Bay (Zealand); but they all agree and may certainly be regarded as applying also to the other tract along the south coast of Lolland and Møen.

The open unprotected situation appears in the fact that the bottom is firm to a fairly great depth, at any rate deeper than the Zostera can live. It is

either pure sand bottom or stony sand-bottom, and in the last case (commonly in somewhat deeper water) we often find a vegetation of delicate algæ (*Ectocarpus*, *Polysiphonia*, *Rhodomela* etc.) and sometimes some *Characeæ* (*Tolypella*, *Chara baltica*). We only find the *Zostera* in scattered, small patches and short and narrow-leaved; the conditions most nearly correspond with those of the Kattegat and the north coast of Zealand, in spite of the great difference in the salinity of the water.

The *Zostera* reaches down to a depth of $5\frac{1}{2}$ fathoms off the east coast of Falster, and to ca. 4 fathoms in Faxe Bay; but the vegetation is so sparse that it is of no practical importance. There is no difference in the *Zostera* plants from the deepest places and those from shallow water.

On the open coasts of Bornholm the *Zostera* is not of any importance to the fisheries; there are only here and there some small scattered patches of short and narrow-leaved plants.

V. The *Zostera* vegetation as a habit for other plants and for animals.

At certain places the grass-wrack is found quite pure, that is, not mixed with other plants; at other places a great many other plants grow among its shoots, as has already been mentioned previously. According to these differences one may speak of a »pure« and a »mixed« *Zostera* vegetation.

Again, the pure *Zostera* vegetation appears under two totally different forms. On the bare, firm and light sand in the Kattegat and elsewhere, where the waves beat vigorously, there is a pure *Zostera* vegetation with rather small, narrow-leaved shoots; it is a poor and sparse growth of no practical importance. The leaves of the shoots are generally clean and without any covering of smaller plants or animals.

A second kind of *Zostera* vegetation with no other plants growing amongst it appears on rich, soft muddy bottom and in protected places. Here the *Zostera* attains its greatest luxuriance, and whereas in the foregoing case it was the unsheltered and unfavourable conditions which caused the absence of other plants, here the vigorous and dense growth of the *Zostera* itself excludes intermixture. The shoots grow as thickly as grass in a meadow, and the leaves attain a length of 1—2 meters. The excellent conditions of life are shown also in that the leaves are covered with a multitude of small plants and animals. In springtime the leaves become hairy and brown, with an abundant growth of *Diatoms*, and later many Algæ are added (*Ceramium*, *Ectocarpus* etc.). Of animals we always find the honey-combed colonies of Bryozoa (*Membranipora*), single and compound Ascidians (*Ciona*, *Botryllus* etc.), hydroid polyps (*Gonothyrea* etc.), tubiculous worms (*Spirorbis*), Lamellibranchs (especially the common mussel (*Mytilus*), see fig. 9) and snails (*Hydrobia*, *Rissoa* etc.). A more detailed list of the animals living on the leaves of the *Zostera* will be found in Report I from the Biological Station, p. 171—176, to which reference may be made.

The »mixed« *Zostera* vegetation may also be of different kinds, varying chiefly with the bottom. The bottom in our sounds with their constantly renewed, streaming water is generally somewhat stony, but consists besides of sand-mixed mud, that is, sand mixed to a greater or smaller degree with fine

particles of inorganic as well as of organic materials. A bottom like this is a nutritive and good place for the plants and here also we find a luxurious vegetation. On the larger stones we find *Fucus vesiculosus* and *Chorda filum* in shallow water, *Fucus serratus*, *Laminaria saccharina* and *digitata* and *Halidrys siliquosa* in somewhat deeper water. The smaller algæ, chiefly the red and brown algæ, often appear as a thick carpet consisting mainly of *Furcellaria fastigiata*, species of *Polysiphonia*, *Cystoclonium*, species of *Phyllophora* and *Rhodomela* of the red algæ, and of the brown algæ: species of *Ectocarpus*, *Pylaiella* and *Desmarestia viridis*. In the thick undergrowth of all these smaller plants we find more or less scattered growths of the eel-grass. Such mixed vegetation is common in the Little Belt, the Great Belt and the Sound as well as in the western parts of the Lim Fjord. It requires for its growth often renewed, somewhat salt water, a necessity for most of the red algæ. To distinguish it from the other kinds of »mixed« vegetation it may suitably be called Red-Alga *Zostera* Vegetation.

Concerning the animal life which is connected with this kind of vegetation, I have unfortunately but little information; it consists partly of the above-mentioned animals,

partly of others which are more closely connected with the algæ than with the *Zostera* and which follow the algæ out to slightly greater depths. In Report III of the Biological Station, p. 29, a general summary is given of the animals which occur in Fæne Sound on »alga-ground«, and it is almost the same as in the case of the Red-Alga *Zostera* Vegetation. The animal life is here upon the whole rich and varied.

The other kind of mixed *Zostera* vegetation may be called the Green-Alga *Zostera* Vegetation or with a more comprehensive term the Brackish-Water *Zostera* Vegetation; it appears namely in the least saline of our waters,

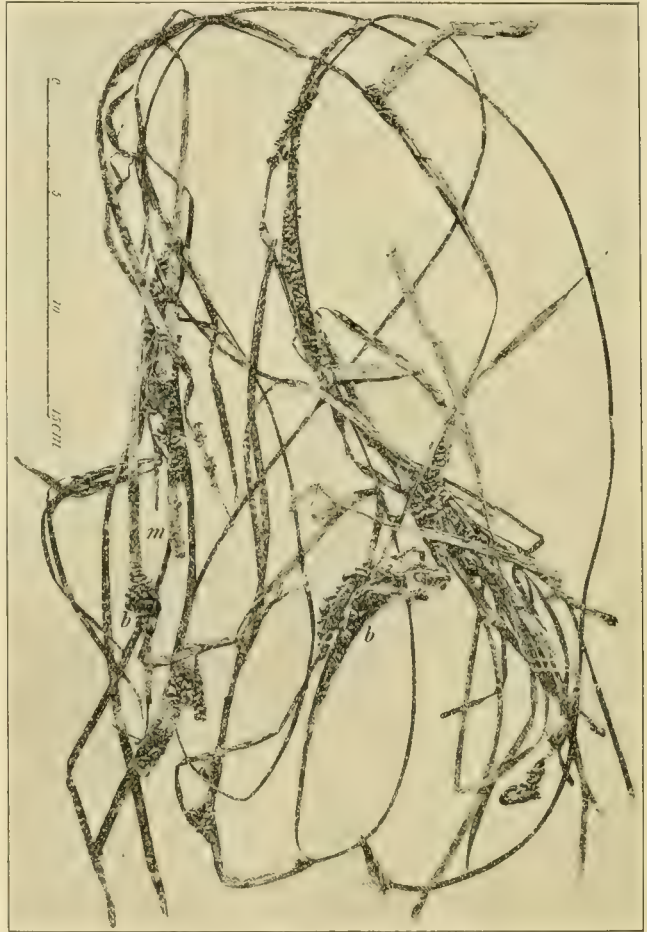


Fig. 9. Flowering shoot of a very long and broad-leaved Mud-*Zostera*. At *b* and several other places we see clumps of small mussels; at *m* colonies of *Membranipora*.

(Soft bottom; off the east side of Livo, Lim Fjord, 2 fm.)

e. g. in Guldborgsund, Ulvstrøm and Bøgestrøm, as well as in the innermost parts of the bays and in half-closed inlets and firths. The bottom is of soft mud or dark, mud-mixed sand. The bottom layer is here partly formed of green algæ (*Cladophora rupestris*, *Chaetomorpha linum*, *Enteromorpha*, *Ulva lactuca* etc.), partly of Characeæ (*Chara*, *Tolypella* and *Lamprothamnus*). Amongst these, besides the *Zostera*, also grow the other marine flowering plants which will be more particularly mentioned below: *Ruppia*, *Zannichellia* and *Potamogeton pectinatus*. The animal life is rich, though not so varied as in the two above-mentioned kinds of *Zostera*; the reason is amongst others that the brackish water fauna is poorer and more uniform than that of the salt water.¹⁾

Of the various small animal forms which are fixed to or crawl over the leaves of the *Zostera*, only very few live on the substance of the leaves, the chief mass live on the microscopic plants and animals which float in the water amongst the leaves; they are thus in reality connected with the *Zostera* only because it offers them favourable conditions to procure nourishment. This is of course also the case with the larger animals which live amongst the *Zostera*; Echinoderms (starfish (*Asterias rubens*) etc.), worms, Lamellibranchs and snails, also Crustacea: prawns (*Palæmon* etc.), crabs (*Carcinus moenas*), Mysidæ, Isopods (*Idothea* etc.) and Amphipods (*Gammarus*, *Proto*). Most of those prowl about for their prey in the rich hunting grounds of the *Zostera*.

The only form of practical importance among these animals is the prawn (*Palæmon Fabricii*), which is always fished for in the *Zostera* vegetation.

The fish fauna which lives in these places may also be briefly mentioned. The most important food fish is the eel (*Anguilla vulgaris*), which is specially connected with the *Zostera* vegetation during the whole of its growth (from the time when it enters our waters as elver until it leaves us), in so far as it does not go up into fresh water. Most of the catch of yellow eels takes place in the *Zostera* vegetation by means of eel-seines or otherwise.

Of but little practical importance are such fishes as the gobies (*Gobius niger*, *minutus* and *Ruthensparri*), the fifteen-spined stickleback (*Spinachia vulgaris*), the three-spined stickleback (*Gasterosteus aculeatus*, the viviparous blenny (*Zoarces viviparus*), needle fish (*Siphonostoma typhle*), and the sea-scorpions (*Cottus scorpius* and *bubalis*), all of which are stationary fish, in any case for a great part of their life, in the *Zostera* vegetation. Other species of fish come in here at certain times, e. g. the garfish (*Belone acus*), herring (*Clupea harengus*) and lumpsucker (*Cyclopterus lumpus*) and others again live here when young, e. g. the cod.

In the various Reports from the Biological Station lists are given of the fishes which live in the different kinds of *Zostera* vegetation. These can be summarized as follows:

1) The fishes of the pure Sand-*Zostera* vegetation are mentioned in Report IX, pp. 37—40 (Northern Kattegat),

¹⁾ At the end of this paper, in the observation material, notes are here and there given of the plants growing amongst the *Zostera*.

2) the fishes of the pure Mud-Zostera vegetation in Report I (Holbæk Fjord) and IX (the harbour at Frederikshavn),

3) the fishes of the red-alga Zostera vegetation in Report III (Fæno Sound), and

4) the fishes of the brackish-water or green-alga Zostera vegetation in Report V, p. 38 (Stege) and p. 42 (Frederikssund).

Among the animals mentioned there are only two in reality which form the object of any extensive fishery, namely, the eel and the prawn, and it might from that be concluded that the Zostera was not of special benefit to our fisheries, and even, since it at times stops up the fixed nets and prevents the setting of gill-nets and the like¹⁾, that it was an evil; but this is certainly an error; I can fully agree with Dr. C. G. Joh. Petersen's sentence quoted as motto for this paper. The rich Zostera vegetation in our waters is one of the principal supports of our fisheries, as it must be considered a most important breeding ground for the nourishment of our food-fishes.

¹⁾ Fiskeriberetningen for 1899—1900, p. 178 and 1900—1901, p. 149.



VI. Dead Weed.

It has already been mentioned (p. 6) that the cast-off leaves of the *Zostera* and the shoots loosened in various ways float about in the water in larger or smaller clusters, until they are either thrown up on the beach or sink to the bottom. The deposition occurs quite by degrees and the sinking masses are often carried a long distance by the currents before they settle. A necessary condition for the settling of the masses of dead weed is, that they should be carried out into depths and places where there are no currents. The dead weed may then be collected into enormous quantities so that it covers the sea-bottom for considerable distances with a thick layer of entangled masses. It is owing to the *Zostera*'s power of resistance to putrefaction that the accumulations can become so enormous; it is quite different with the sea-weeds (algæ) which very quickly crumble and decay. The dead weed is of no inconsiderable importance to our waters, as it impedes fishing with seines at several places and as the bottom, where the dead weed forms a thick cover, is not a good place for the animals living in the upper layers and on the surface of the sea-bottom, many of which are of importance as food for our food-fishes, especially flat-fish.

If one consults a chart showing the depths in our marine waters, one might almost calculate where there are accumulations of dead weed. It must be sought for in the deeper bays and at the bottom of the channels through our waters, especially in the deep parts of the channels. The dead weed in contrast to the living *Zostera* may occur in fairly great and very varying depths.

In the observation material at the end of this paper, the data of the occurrence of the dead weed which I have been able to procure are stated; but they only give an indication of its distribution in our waters. I think, however, that they indicate where there is much dead weed. Referring for details to the observations themselves, I may here, as in stating the distribution of the living *Zostera*, give a short survey of the most important places where it occurs.

1. West coast of Jutland. So far as I know, there are nowhere large accumulations of dead weed off the west coast of Jutland, and the conditions for these — plentiful growth of the *Zostera* and little motion on the sea-bottom — are also lacking, unless perhaps at Esbjerg.

2. The Lim Fjord. The conditions are quite different here and greatly favour the formation of dead weed. The movement of the waves carries the loose *Zostera* from the coastal margins to deeper parts, and on account of the very small current, the dead weed may be deposited almost everywhere. The investigations also show in reality, that the dead weed is widely distributed in Nissum Bredning, Venø Bugt, Kaas Bredning and Thisted Bredning (see the Chart fig. 7). At many places the dead weed is mixed with the *Furcellaria* vegetation, frequently for example in the Nissum Bredning.

3. Kattegat. Large masses of dead weed are found in the Læsø Channel as well as in the deep channel east of Læsø, as is shown on the Chart fig. 8. On the other hand, there is not much dead material in the large shallow plateau of Aalborg Bay, as suitable deep places are wanting.

More to the south where the depths in the Kattegat become more varied, there are distinct channels and deep, calm fjords and the accumulations of dead weed reappear here and there, e. g. in Baaring Vig and the bay west of Hindsholm.

5. Little Belt. Large masses of dead weed are found north of Brandsø, also all along the west and south coasts of the island of Funen, in depths of 8 fathoms and more.

6. Great Belt and Langeland Belt. The conditions here are similar to those in the Little Belt. In the channels between Romsø and Sprogø, as well as over a large tract south-east of Sprogø, large masses of dead weed are to be found in 10—20 fathoms of water, likewise on both sides of Vresen and down through the waters between Funen and Langeland. The current has also carried considerable quantities of dead weed down into the deep channel between Aggersø and Zealand.

As regards the other waters, I have too little information to be able to make any statements with confidence. It may however be mentioned, that south of Glænø in the Smaaland Waters dead weed is found in 6—7 fathoms and most probably the same is the case at many other places in the Smaaland Waters. Finally, some dead weed has been found in the Baltic south of Rødsand in 12—14 fathoms of water, and according to J. Reinke (l. c.) it seems to be fairly common in the whole of the Western Baltic.

VII. The other marine flowering plants.

In Professor Warming's work several times referred to on the »strand vegetation« of Denmark, the few other marine flowering plants are described in detail so that I need only mention them shortly, the more so as they only rarely occur in such quantities as to play any important part in the practical fishery.

1. The small, above mentioned (p. 17) Dwarf *Zostera* or Dwarf Grass-wrack (*Zostera nana* Roth) resembles in its structure the common *Zostera*, but is on the whole smaller and more delicate. It most often grows on sand bottom in quite shallow water, from the low water mark to about $\frac{1}{2}$ fathom, often only to 1—2 feet in depth. The slender, brownish yellow, horizontal root-stock is hidden in the sand, and from that projects the 10—20 cm. long, quite narrow (1,5—2,5 mm.) ribbon-like leaves; the flowering shoots are generally single or a few together and never form long, much branching, fan-shaped shoots as the common *Zostera* does. The fruit is much smaller, often of a reddish purple colour, and the seeds are not longitudinally striped.

The dwarf *Zostera* is found here and there along all our coasts where there is little motion; as it grows so near land, it cannot thrive where the waves beat strongly. It generally forms small, pure, fairly open and poor vegetations; thus it occurs in the ditches on the »Vader« on the east coast of Fanø, at Nymindegab in Ringkøbing Fjord, off Holtemme on the north side of Læsø and at many other places; not rarely we find patches of dwarf *Zostera* alternating with patches of narrow-leaved and low, common *Zostera*.

The dwarf *Zostera* can, like this, thrive in real salt water, as the above-mentioned places show; it is however more frequently found in our inner waters; I may thus mention as examples Stavns Fjord on Samsø, Randers Fjord at Udbyhøj, Korshavn on Fynshoved and Nakskov Fjord.

It is of no importance as nourishment or as shelter to the marine animals, as it is too delicate and its occurrence is besides too scattered and it never covers large tracts. —

The remainder of our marine flowering plants are all brackish water plants; they do not stand the real salt water and are thus absent along the west coast of Jutland, in the Lim Fjord (excepting, however, the least saline nooks, e. g. Hjarbæk Fjord), and in the northern and central Kattegat. The degree of

saltiness which they can stand scarcely exceeds ca. 2 p. c. They require* for their growth, further, a still more protected place than the common *Zostera*, and none of them go out to any great depths; J. Reinke (l. c.) states that *Zannichellia* and *Potamogeton pectinatus* occur to 5 meters depth, and I have found the same plants to ca. 4 meters depth.

The plants spoken of here are: *Ruppia*, *Zannichellia* and *Potamogeton pectinatus* L. Besides these, one may in very slightly saline water, e. g. in firths and creeks into which streams open, meet with others that cannot really be called marine plants, thus *Najas marina* L., *Myriophyllum spicatum* L., *Ranunculus Baudotii* Godr. and *Scirpus pavulus* R. & S.; these will not be discussed here.

2. *Ruppia maritima* L. resembles in its growth dwarf *Zostera*. There is a creeping rootstock, which is generally pale (whitish), and from this issue thread-fine 8—25 cm. long leaves with a lower, somewhat dilated sheath-part. Branches issue from very many of the axils of the root-stock so that the *Ruppia* forms a net-work in the sandy or soft bottom on which it grows. The branches may end in an inflorescence which consists of the flowers only, placed at the end of a shorter or longer stalk; this stalk in the *Ruppia* growing in fairly deep water is often very long and reaches the surface, so that the flowers can open in the air. The pollen is so constructed that it can float on the water (the pollen grains are curved and short, sausage-shaped) and be carried by the wind to the stigma; at the end of June I have seen it in such quantities at certain places in Guldborgsund that the water looked as if it were covered with a pale-yellow, fine powder. When the fertilisation is completed, the stalk curves itself up spirally, so that the fruit will ripen in the water. In other forms of the *Ruppia* the stalk is always short, and it must be supposed that fertilisation in these cases takes place down in the water.

The *Ruppia* grows in shallow water from the low water mark and to ca. 1 meters depth (perhaps 2 meters); it forms fairly extensive vegetations in a fringe beyond the beach on almost all the coasts of our inner waters, if the place is fairly protected. The most northern places, where I have seen it, are in Hobro and Randers Fjord, at Læsø, and also in Stavns Fjord on Samsø; but it is especially in the waters south of Zealand and Funen, round about the small islands, that it occurs in large quantities. The short and fairly dense vegetation is of a dark brownish-green colour, and resembles a grass-lawn under the water, as the leaves of the *Ruppia* are extremely fine (ca. 1 m. broad) and thread-like.

3. *Zannichellia palustris* L. occurs more rarely in large pure vegetations than the *Ruppia*, but it may on the other hand go deeper down in the water, to 4—5 meters, and seems to prefer softer bottom. Some shoots creep along or are but little submerged in the ground, others rise more or less perpendicularly in the water. It has thread-fine, 2—8 cm. long leaves placed in whorls of 2—4, most often 3, at each joint of the stem. In the axils of the leaves, which have no sheath, we find the small flowers, which consequently open and are fertilized down in the water. The fruits (generally 4 together) are crescent-shaped and thorny on the outside of the curve.

Zannichellia is a trifle more sensitive as regards saline water; it lives in the real brackish water, and is e. g. common in Kalvebodstrand, in the Bøgestrøm

and in Guldborgsund. I have also met it in the open Baltic off Falster (in Hesnæs Bay) in 2—2½ fathoms. It is of no great importance.

4. More important is *Potamogeton pectinatus* L., which in ability to stand the salt water comes between *Ruppia* and *Zannichellia*. It is a larger and more vigorous plant than the latter. Its pencil-thick, white rootstock creeps horizontally in the bottom at a certain depth and ends in a pointed bud with which it bores its way forward. From the root-stock issue erect, often meter-long shoots, which are richly branched in one plane, so that they become fan-shaped. The branches are supported by leaves and themselves bear leaves; these are thread-like (about 1—1,5 mm. bread), fairly stiff and with somewhat dilated sheaths. At the end of the shoot there is a many-flowered inflorescence on a thin and flabby stalk. During the flowering time the inflorescence generally lies on the surface of the water, so that the flowers open to the air, but after fertilization it is lowered down into the water, where the brownish fruits ripen.

Potamogeton grows in mud-mixed sand or in pure mud, and forms more or less dense growths, often of considerable extent. It always grows in protected places, as for example in Ringkøbing Fjord, Albu Fjord, Roskilde Fjord, Guldborgsund and Grønsund etc. It occurs from a little beyond the low-water mark (ca. 1 foot) to 2—3 fathoms depth.

The fishermen do not like it, as the strong and tough shoots check the progress of the seine-nets along the bottom.

Together with these brackish-water flowering-plants *Characeæ* often occur in great quantities: *Chara* and allied genera (*Tolypella* and *Lamprothamnus*); these will not be discussed in this paper as they do not belong to the plants related to the *Zostera*; but they deserve a closer investigation, as, owing to their extensive occurrence, they are of practical importance to the fisheries at some places, e. g. all along the south coast of Zealand from Faxe Bay to Skelskør.

VIII. Table of measurements of the length and breadth of the leaf and of the length of the flowering shoot.

	The length of the leaves in cm.	The length of the leaf-sheaths in cm.	The breadth of the leaves in mm.	The length of the flowering shoots in cm.
2. Lim Fjord.				
^{27—30} / ₇ 01.				
1. Livø Bredning, 3 ¹ / ₂ —3 fm. Soft (sticky) ground. Østløs church in N.N.W. ¹ / ₂ W. and Aggersborg church E. by N.	90. 93. 110. 123.	15. 18. 23. 23.	3,5. 4. 5. 6.	195.
2. Nissum Bredning, Hvidbjerg church in E. by N. 2 ¹ / ₂ fm. Sand ground.	75. 50. 83. 83. 78.	20. 10. 20. 23. 18.	3,5. 4. 4. 3,5. 3,3.	115.
3. Nissum Bredning, between Helligsø brickfield and Røjensø Odde. 2—3 fm. Stones and gravel.	110. 70. 95. 80. 120. 110.	— — — — —	5. 4. 5. 4,5. 5.	115. 80. 90. 110. 80.
4. Nissum Bredning, E. of Ronland. 2 ¹ / ₄ fm. Hard ground.	115. 145. 175. 155. 140. 110. 150.	— — — — —	4,5. 5,5. 5. 4,5. 5. 4,5. 5.	— — — — —
5. Nissum Bredning, E. of Stenodden. 2 ¹ / ₂ fm. Hard ground.	165. 110.	40. 25.	5. 4,5.	160. 200.
6. Nissum Bredning, N.E. side of Rønne. 2 ¹ / ₄ —2 ¹ / ₂ fm. Hard(?) ground.	140. 130. 115. 140.	— — — — —	5,5. 4,5. 4. 5.	150. 140. 125. 160. 140. 155. 165. 125. 160.
7. Livø Bredning, E. of Livø brickfield. 2 ¹ / ₂ —2 fm. Soft ground.	233. 213. 215. 208.	65. 70. 55. 60.	8. 8. 8. 7,5.	245. 260. 210. 220. 250. 200. 195. 225.
8. Off Nykjøbing, Mors. 2 fm. Soft ground.	178. 168. 190. 190.	50. 45. 48. 55.	7,5. 7. 7. 7.	230. 185. 180.
3. Kattegat.				
^{24—31} / ₇ 01.				
1. Treaa Molle in S. 2 miles. 4 ¹ / ₂ fm. Sand ground.	70. 83. 85.	18. 18. 18.	6. 5,5. 5.	

	The length of the leaves in cm.	The length of the leaf-sheaths in cm.	The breadth of the leaves in mm.	The length of the flowering shoots in cm.
2. Muldbjærge in W. $\frac{1}{2}$ S. 4 miles. 3 fm. Hard ground.	90.	23.	3. — 4.5. (28 mea- surements).	85.
3. A little N. of the broom at Østre Flak, S. of Læsø. Hardly 6-4 fm. Hard ground.	48. 65. 63.	11. 15. 13.	3. 4. 3.5.	80. 120. 130. 55.
4. Muldbjærge in W.S.W., Jutland Aas in N.W. $\frac{1}{2}$ N. $4\frac{1}{2}$ fm. Hard ground.	105. 103. 83. 60.	20. 20. 18. 13.	5. 5. 4.5. 5.	145. 140. 150. 130. 130.
5. Als church in W.S.W. $9\frac{1}{2}$ miles. $5\frac{1}{2}$ fm. Pure sand ground.	75. 85. 70. 68. 60.	13. 18. 15. 11. 10.	4.5. 4.5. 4.5. 4.5. 5.	110. 105. 90.
6. In the middle of Gjerrild Bay. 4 fm. Sand ground.	75. 60. 93.	15. 15. 23.	5. 5. 5.5.	— — — — —
4. The Waters between Jutland and Samsø.				
$\frac{23-24}{7}$ 01.				
1. Off the north side of As- hoved.				
a. $5-3\frac{1}{2}$ fm. Soft ground.	120. 190.	— — — — —	7.	200.
b. 2 fm. Soft ground.	90. 110.	— — — — —	6.	
2. Off Skødshoved. 5 fm. Soft ground.	128.	40.	7.	— — — — —
3. West side of Sletterhage. $5\frac{1}{4}$ fm. Hard ground.	ca. 100.	— — — — —	4.	185.
7. Samsø Belt.				
$\frac{23}{7}-\frac{1}{8}$ 01.				
1. Off Ljus harbour at Samsø. $3\frac{1}{2}-3$ fm. Hard ground.	55. 70.	— — — — —	3. 4.	55.
2. Off Udsager Hage. $5-4\frac{1}{2}$ fm. Hard, stony ground.	75. 53. 40. 70.	20. 15. 10. 15.	5. 5. 4. 4.5.	100.
3. North of Ballen. $5\frac{1}{2}$ fm. Stony ground.	113. 135. 123.	33. 35. 33.	5. 5. 5.	183.
4. Off Horseklint. $5\frac{1}{4}$ fm. Stony ground.	113. 153. 143. 118. 128. 120.	— — — — —	4.5. 5. 5. 4. 4. 4.	— — — — —
5. S. of Bøgebjærg. $4\frac{1}{2}-4$ fm. Hard ground.	190. 78. 203. 195. 160. 145.	— — — — —	6. 5.5. 5.5. 5.5. 5. 5.	— — — — —
8. Great Belt and Langeland Belt.				
$\frac{2}{3}$ 01.				
1. East side of Vresen Puller.				
a. ca. $4\frac{1}{2}$ fm. Hard ground.	130. 105. 120.	— — — — —	5.5. 5. 5.	— — — — —
b. ca. 3 fm. Hard ground.	100. 118. 95. 95.	— — — — —	5. 5. 4.5. 4.5.	— — — — —
2. Off Hou on Langeland.				
a. $4\frac{1}{2}-4$ fm. Hard ground.	135. 125. 93. 125.	40. 43. 28.	5.5. 5. 5.	— — — — —
b. ca. 3 fm. — —	78. 105. 95.	25. 35. 30.	4.5. 4.5. 4.5.	— — — — —
c. ca. 2 — — —	100. 95.	33. 28.	5. 4.5.	— — — — —

	The length of the leaves in cm.	The length of the leaf-sheaths in cm.	The breadth of the leaves in mm.	The length of the flowering shoots in cm.
3. Off Nedergaard on Lange- land. 5 $\frac{1}{2}$ fm.	143. 150. 170. 170. 163. 123. 122. 110. 140.	— — — — —	5. 6. 5,5. 5,5. 5,5. 5. 5. 5. 5.	— — — — —
4. Off Spodsbjærg. 4 $\frac{1}{2}$ fm.	200. 223. 170. 190. 165.	— — — — —	5,5. 6. 5. 6. 5,5.	250. 220.
9. North coast of Zealand.				
²²⁻²³ / ₇ 01.				
1. Off Hornbæk, due west of the boat harbour. a. nearly 5 fm. b. 4 fm. Hard sand ground.	160. 140. 123. 125. 135. 113.	35. 30. 30. 28. 33. 28.	5. 4,5. 4,3. 4,3. 4. 4,5.	— — — — — 98. 113.
2. Creek off Havnsø Mølle, Nekselø Bay. a. 4 fm. Soft ground. b. 3 $\frac{1}{2}$ fm. Soft ground. c. 1 $\frac{1}{2}$ fm. Hard ground.	175. 115. 143. 120. 150. 130. 38. 45. 38.	35. 35. 48. 40. 38. 48. 10. 13. 11.	7. 5,5. 6,5. 7. 6. 7. 3. 2,8. 3.	160. 168. 175. — — — — — — — — — —
3. Off the N.W. corner of Nekselø 3 $\frac{1}{2}$ —3 fm. Hard sand ground.	48. 38. 35.	— — — — —	ca. 3,5.	— — — — —
4. Off Lille Vrøj. 2 $\frac{1}{2}$ fm. Sand ground with stones.	38. 33. 25. 23.	— — — — —	ca. 3.	— — — — —
5. Off Hestehavegaard on the north side of Refsnæs. 3 fm. Hard ground.	20. 25.	— — — — —	3,3.	— — — — —
11. The Sound.				
²⁰ / ₇ 01.				
1. Within »Trekost« at Prø- vesten. 3—3 $\frac{1}{4}$ fm.	135. 113. 115.	35. 30. 33.	7. 6,5. 6.	— — — — —
2. Between »Tokost« and »Trekost« on Middelgrund. 2 fm.	105. 120. 110.	23. 40. 37.	5. 6. 6,5.	— — — — —
3. »Etkost« at Sundbyhage. 4—4 $\frac{1}{2}$ fm.	160. 123. 133.	55. 35. 40.	7. 6. 7.	— — — — —
4. Within the broom at Svalerumpe. 3 fm.	123. 125. 135. 100. 90.	35. 30. 40. 27. 30.	6. 6. 6. 5. 6. 6.	— — — — —
5. Within the buoy at Ka- strup Knæ. 3 $\frac{1}{4}$ —2 $\frac{1}{2}$ fm.	120. 105. 107.	30. 25. 37.	8,5. 8. 6.	70.
6. Side of Saltholm, off the boat bridge. a. 3 fm. b. 2 fm.	95. 53. 55. 40.	25. 15. 15. 13.	6. 3,5. 4. 3.	— — — — — — — — — —
7. Within the broom at Salt- holm Flak. a. 3 fm. b. 2 fm.	115. 108. 50. 65. 58.	35. 35. 13. 18. 15.	5,5. 6. 4. 3. 3,5.	— — — — — — — — — —

	The length of the leaves in cm.	The length of the leaf-sheaths in cm.	The breadth of the leaves in mm.	The length of the flowering shoots in cm.
8. E. and S.E. of the bell- buoy on Saltholms Flak. 4—2 $\frac{1}{2}$ fm.	58. 63. 87.	15. 15. 23.	4,5. 5. 4,5.	80.
9. Between Taarbæk Reef and the coast. 3 fm.	103. 113. 103. 123.	28. 33. 30. 38.	5,8. 6,5. 6,5. 5,5.	60. 90. 118. 128.
10. Off Skodsborg landing stage, Lower side. 4—3 $\frac{1}{2}$ fm.	163. 160.	43. 38.	7. 7.	160. 225.
11. Off Rungsted landing stage. 3 fm.	88. 110. 85.	30. 30. 25.	5. 4,5. 5.	80.
12. Nivaa Bay. 2 fm.	63. 50. 65.	20. 15. 18.	4,5. 4,5. 5.	
12. Smaaland Sea. 3—7 $\frac{1}{8}$ 01.				
1. Off Kragenæs harbour. 2—3 fm. Soft ground.	118. 120. 113. 88. 98.	— — — — —	7. 7. 7. 6,5. 6,5.	93.
2. Vigso church in W. Guld- borg L. in S. by E. $\frac{1}{2}$ E. Nearly 3 fm. Soft ground.	120. 138. 120. 100. 108.	— — — — —	6,5. 7. 6,5. 7. 6,5.	180. 155.
3. Off Knudsby. 3 fm. Sandy ground.	68. 60. 80. 75. 65.	— — — — —	4. 4. 5. 4. 4.	— — — — —
4. Venegrund. 4 fm.	83. 78. 73.	— — — — —	6. 6. 5.	— — — — —
5. Kirkegrund. 4 fm.	103. 95. 100.	— — — — —	6. 5,5. 5,5.	— — — — —
6. Basnæs i N. by E. 3 miles. 4 fm.	95. 125. 123.	— — — — —	6. 5,5. 6.	— — — — —
7. Helleholms Lighthouse in N.W. $\frac{1}{2}$ N. 2 miles. a. 3 $\frac{1}{2}$ fm.	88. 100. 103. 80. 83. 73.	— — — — —	4. 5. 5. 4,5. 5. 4,5.	— — — — —
b. 4 $\frac{1}{2}$ —5 fm.	130. 143. 140. 110.	— — — — —	6. 6. 6. 5,5.	— — — — —
8. The buoy at Omø Tofte. a. Nearly 5 fm.	140. 98.	— — — — —	5,5. 5.	— — — — —
b. 2 fm. Sand ground.	60. 40. 80. 58. 53. 53. 70. 63.	— — — — —	4. 5. 5. 5. 5. 4,5. 5. 5.	60. 55. 63. 50.
13. Guldborgsund. $\frac{5}{8}$ 01.				
1. Between Hasselø and Kalvø. ca. 1 $\frac{1}{6}$ fm. Hard ground.	130. 170. 158. 125. 135.	— — — — —	4,5. 4,5. 4. 4,5. 4,5.	— — — — —
2. Hasselø Bredning. ca. 1 $\frac{1}{6}$ fm. Hard ground.	70. 65. 70. 65. 73. 58.	— — — — —	4. 4. 4. 4. 4,5. 3,5.	— — — — —

	The length of the leaves in cm.	The length of the leaf-sheaths in cm.	The breadth of the leaves in mm.	The length of the flowering shoots in cm.
3. Flinthorne Reef in N. by E. $\frac{1}{2}$ E. 3 fm. Soft ground.	110. 95. 103. 100. 73. 105.	— — — — —	7. 6.5. 7. 6.5. 6. 6.	95.
4. Nysted church in N.E. by N. $\frac{1}{2}$ N. 2 fm. Soft ground.	105. 115. 128. 115. 105. 135. 115. 115. 108.	— — — — —	4.5. 5. 5.5. 6. 5. 5.5. 6. 5. 5.	80.
5. Within Rødsand, at Fugle- holm. Soft ground. a. ca. 2 fm.	135. 108. 130. 100. 120.	— — — — —	6.5. 5.5. 5. 6.5. 6.5.	105. 135. 93. 120. 100. 105. 95. 88.
b. ca. 3 fm.	140. 125.	— — — — —	8. 7.5.	— — — — —
6. Skælby church in N. by E. $\frac{1}{2}$ E. Gedser harbour light- house in S.E. $2\frac{3}{4}$ fm. Soft ground.	120. 110. 128.	— — — — —	6.5. 6. 7.	— — — — —
14. Bøge Stream.				
$\frac{6}{8}$ 01.				
1. North of west end of Tærø. 2 fm. Soft ground.	165. 155. 150. 155.	— — — — —	6.5. 6. 5. 5.5.	— — — — —
2. North of N. Knigge. $1\frac{1}{2}$ fm. Soft ground.	98. 105. 90. 103. 95. 75.	— — — — —	4.5. 5. 5. 5. 5. 4.5.	— — — — —
15. The Baltic.				
$\frac{5-6}{8}$ 01.				
1. Tromsø i N.W. by W. $5\frac{1}{2}$ — $2\frac{1}{2}$ fm. Stony ground.	68. 60. 48. 75. 50. 33. 35. 25.	— — — — —	3.5. 3.5. 3. 3.5. 3.5. 2.5. 3. 3.	— — — — —
2. Hesnæs Bay. $2\frac{1}{2}$ —2 fm. Sand ground.	43. 55. 48. 50. 40. 45.	— — — — —	3.5. 3.5. 3.5. 3. 3.5. 3.5.	60. 85.
3. Outside the Bogestrom buoy. 2 fm. Sand ground with stones.	33. 43. 33. 45. 38. 35. 45. 38.	— — — — —	3. 3. 3. 3. 3. 3. 3. 3.	— — — — —
4. Off Faxø. 4 fm. Sand ground.	63. 83. 65. 58. 55. 65.	— — — — —	3.5. 4. 4. 4. 3.5. 4.	— — — — —

IX. The Material collected and observed.

The data below are partly from my own investigations, partly from observations made by the Danish Biological Station; the latter observations are copied from the Station's Journals which Dr. C. G. Joh. Petersen kindly entrusted to me. My observations extend over the period between July 20th and August 9th 1901. The rest of the observations are nearly all from the Biological Station. The statements about occurrence of dead weed are only separated from the other observations for the Lim Fjord, Kattegat, Little Belt and Great Belt, as they are more numerous for these places.

The grass-wrack is everywhere denoted here by »Zost.«, viz. »*Zostera*«. The few other abbreviations need no special explanation.

2. Lim Fjord.

- ²⁹/₇ 01. Nissum Bredning. Between Helligso brickfield and Røjenso Odde.
3—2 fm. Stones and gravel. At places, medium long and medium broad-leaved Zost.
- ²⁹/₇ 01. Nissum Bredning. Hvidbjærg church in E. by N.
3 fm. Sand ground. No Zost.
- ²⁹/₇ 01. Nissum Bredning. E. of Rønland.
 $2\frac{3}{4}$ — $2\frac{1}{2}$ fm. Quantities of *Furcellaria*. No Zost.
- ²⁹/₇ 01. Nissum Bredning. Same place, a little nearer land.
 $2\frac{1}{4}$ Fv. Long, medium-broad Zost.
- ²⁹/₇ 01. Nissum Bredning. E. of Stenodden.
 $2\frac{1}{2}$ fm. Long, medium broad Zost.
- ¹⁰/₈ 00. Nissum Bredning. Gjellerodde on Lemvig Fjord.
 $1\frac{2}{3}$ fm. Mud ground. Long and broad-leaved Zost.
- ²⁹/₇ 01. Nissum Bredning. N.E. side of Rønne.
 $2\frac{1}{2}$ — $2\frac{1}{4}$ fm. Zost. and *Furcellaria*.
- ²⁹/₇ 01. Nissum Bredning. Kamstrup Bakke in S.
3—2 Fv. Sand ground. No Zost.
Ob. The white disc. to be seen at $2\frac{3}{4}$ fm.
- ²⁹/₇ 01. W. of Oddesund N. Højbjærgøje over Oddesund N.
3—2 fm. Sand ground. No Zost.

- $\frac{6}{7}$ 99. At Oddesund N.
 $3\frac{1}{2}$ — $2\frac{1}{2}$ fm. Thick growth of long Zost.
- $\frac{1}{7}$ 99. E. side of Venø.
 3 — 2 fm. Zost. vegetation.
- $\frac{27}{7}$ 00. Creek north of the Ferry harbour on Thyholm.
 Long Zost.
- $\frac{6}{7}$ 99. Næs Sound.
 $3\frac{1}{2}$ — 2 Fv. Dense growth of long Zost.
- $\frac{12}{8}$ 00. Salling Sound at Gammeløre.
 $\frac{3}{8}$ fm. (75 cm.) Sand ground at places medium long, rather broad-leaved Zost.
- $\frac{20}{7}$ 01. At Nykøbing outlet.
 Long and broad-leaved Zost. Rich growth.
 In shallow water, S. of the Harbour, 1 — $\frac{1}{3}$ fm., shorter but still rather broad-leaved Zost.
- $\frac{11}{8}$ 00. Thisted Bredning. Fegge Sound in E., Osterild church in N.
 $2\frac{1}{2}$ fm. Sandy and hard ground, partly with Furcellaria, plenty of long and broad-leaved Zost.
- $\frac{4}{8}$ 00. Fur Sound.
 Zost. [»Grass-ground«.]
- $\frac{5}{7}$ 99. S. of Fur church.
 1 — $\frac{1}{3}$ fm. Zost.
- $\frac{30}{7}$ 01. E. side of Livø Tap.
 Scarcely 3 fm. Soft ground with scattered stones. No Zost.
- $\frac{39}{7}$ 01. E. of Livø brickfield.
 $2\frac{1}{2}$ — 2 fm. Soft ground. Very long and broadleaved Zost.
- $\frac{14}{8}$ 00. Off Løgstør Grounds. Bulbjerg i N., Løgstør church in E.S.E.
 3 — $2\frac{1}{2}$ fm. Sandy ground. Long, but rather narrow-leaved Zost. in sparse growths.
- $\frac{27}{7}$ 01. Løgstør Bredning. Off Løgstør Ground.
 The observations commenced at scarcely 3 fm., and were continued to scarcely $3\frac{1}{2}$ fm., Østløs church then being in N.N.W. $\frac{1}{2}$ W., and Aggersborg church in E. by N.
 Everywhere long, medium broad-leaved Zost.
- $\frac{27}{7}$ 01. Østløs church in N.N.W. Aggersborg in E. by N.
 At $3\frac{1}{2}$ fm. the ground was bare (without Zost.).
- $\frac{4}{7}$ 99. E. of Løgstør Canal.
 Scarce Zost. growth.
- $\frac{15}{8}$ 00. Atruplaa.
 2 fm. Soft ground. Long and broad-leaved Zost.
- $\frac{15}{8}$ 00. The Bay north of Trolldholmene.
 In the channel at $2\frac{1}{2}$ — $1\frac{1}{2}$ fm. Broad-leaved, rather long Zost. in rich growth.
 At the edge of the channel towards the shallow water the Zost. shorter and more narrow leaved.
 The shallow water at $\frac{1}{2}$ — $\frac{1}{3}$ fm. and inwards has clean, bare sand bottom.
- $\frac{15}{8}$ 00. On the grounds S. of Øland the Zost. forms extensive growths like green meadows, to be seen at ebbside.
- $\frac{15}{8}$ 00. The channel S. of Gjøl.
 Ca. 2 fm. Long, broad-leaved Zost.
- $\frac{15}{8}$ 00. Langerak, at the margin.
 2 — $\frac{1}{2}$ fm. Very large Zost.

Dead Weed.

- $\frac{2}{5}$ 00. N.E. of 1st broom on Thyborøn Fjordgrund.
 Some Dead Weed.

- $28\frac{1}{7}$ 00. Ledbjærg Lighthouse in N., Røjensø brickfield i N.E. by E.
Dead Weed and green Algæ.
 $28\frac{1}{7}$ 00. S. of Thyborøn Fjordgrund.
Dead Weed.
 $2\frac{1}{5}$ 00. »Enkosten« at Lemvig Røn in S.W. $1\frac{1}{5}$ miles.
Some Dead Weed.
 $3\frac{1}{5}$ 00. N. Nissum church in S.W. $\frac{1}{2}$ W. 3 miles.
Furcellaria and some Dead Weed.
 $3\frac{1}{5}$ and $6\frac{1}{8}$ 00. N. Nissum church in S.W. $\frac{1}{2}$ S. $4\frac{1}{2}$ miles.
Some Dead Weed.
 $2\frac{1}{5}$ 00. N. Nissum church in S. $\frac{1}{2}$ W. $2\frac{1}{2}$ miles.
 $3\frac{1}{2}$ fm. Lots of Dead Weed and Furcellaria.
 $3\frac{1}{5}$ 00. N. Nissum church in W. by N. $3\frac{2}{5}$ miles.
Dead Weed and Furcellaria.
 $30\frac{1}{7}$ 00. Venø Bugt. Humlum church in W.N.W.
3 fm. Dead Weed.
 $31\frac{1}{7}$ 00. Venø Bugt. Struer church in S.S.W. $\frac{1}{4}$ W., Humlum church in N.W. by W. $\frac{1}{2}$ W.
Dead Weed.
 $30\frac{1}{7}$ 00. Venø Bay. Struer church in N.W. by W. $\frac{1}{2}$ W.
3 fm. Lots of Dead Weed and Furcellaria.
 $27\frac{1}{7}$ 00. Kaas Bredning. Gammellund in N., Boløre Odde in W.N.W.
3 fm. Dead Weed.
 $27\frac{1}{7}$ 00. In the middle of Kaas Bredning.
3 fm. Dead Weed.
 $1\frac{1}{7}$ 99. Vilsund.
Ca. 8 fm. Great quantity of Dead Weed.
 $5\frac{1}{5}$ 00. Thisted church in N., Silstrup Hoved in W.
Dead Weed and red Algæ.
 $5\frac{1}{5}$ 00. Thisted church in N. by W. $2\frac{2}{3}$ miles.
A quantity of Dead Weed.
 $5\frac{1}{5}$ 00. N. of Hanklit. 1 mile.
Dead Weed.
 $15\frac{1}{5}$ 00. Langerak, in the course.
5 fm. A little Dead Weed.

3. Kattegat.

- $30\frac{1}{6}$ 98. Aalbæk Bugt.
Sand ground. Zost.
 $29\frac{1}{6}$ 98. Within Hirtsholmene.
5—6 fm. Zost.
 $30\frac{1}{8}$ 01. At Hirtsholmene.
Long Zost.
 $21\frac{1}{7}$ 00. N. of Frederikshavn Harbour.
 $\frac{2}{3}$ — $\frac{1}{3}$ fm. Zost.
 $23\frac{1}{7}$ 00. S. of Frederikshavn Harbour.
Zost.
 $29\frac{1}{6}$ 97. Sæby church in S.W. by W. $\frac{1}{4}$ W., Bangsbo Bakke in N.N.W. $\frac{3}{4}$ W.
5 fm. Zost.
 $29\frac{1}{8}$ 01. At Asaa, the outer side of Rimmen.
 $4\frac{1}{3}$ —3 fm. Large Zost.

- $2\frac{1}{i}$ 00. Asaa in N.N.W.
 4 fm. Quantity of large Zost.
- $1/\text{N}$ 00. Læsø. Ronne Reef, N. of Holtemme.
 Sand ground. Shallow water.
 Near land: Zost. nana; further out: short, narrow-leaved Zost.
- $1/6$ 01. A little S. of »Trekosten« on Flyndergrund, Læsø.
 6—5 fm. Short, growing Zost.
- $26/7$ 01. Læsø Channel light-ship in N.W. by N. $1/2$ N. 6 miles.
 6—5 fm. A little living Zost., a quantity of Dead Weed and Furcellaria.
 Further towards the shore in the direction of Flakket, scattered patches of
 Zost. in ca. $3\frac{1}{2}$ fm. on sand ground.
- $26/7$ 01. A little N. of the broom on Easter-Flak, S. of Læsø.
 Quite 6 fm. Hard ground. No Zost.
 6— $5\frac{1}{2}$ Fv. A little living Zost.; and some dead.
 5—4 fm. Hard ground. Patches of Zost.
- $8/9$ 01. Eastern Knold. S. of Læsø.
 4—3 fm. Fast ground. Small patches with Weed.
- $26/7$ 01. Between Eastern and Western Knold.
 $5\frac{1}{4}$ fm. Hard ground. Very little Zost.
- $26/7$ 01. Muldbjerge in W.S.W. Jutland Aas in N.W. $1/2$ W.
 7—6 fm. Hard ground with stones. No Zost.
- $26/7$ 01. Muldbjerge in W.S.W., Jutland Aas in N.W. $1/2$ N.
 $4\frac{1}{2}$ fm. Hard ground. Rather a quantity, short and narrow-leaved Zost.
- $26/7$ 01. Muldbjerge in W.S.W., Jutland Aas N.N.W.
 $4\frac{1}{2}$ Fv. Hard ground (pure sand). Sparse, short and small-leaved Zost.
- $10/7$ 99. Vejdyb, at Hals.
 Long Zost.
- $10/7$ 99. Between Muldbjerge and Hals.
 A little Zost. and a quantity of Dead Weed.
- $16/8$ 00. S.E. of Muldbjerge broom.
 $2\frac{1}{4}$ fm. Some Zost. but rather small.
- $28/6$ 97. Muldbjerge in N.N.W. Jutland Aas in N. $1/2$ W.
 $3\frac{1}{4}$ fm. Light sand ground with patches of Zost.
- $25/7$ 01. Muldbjerge in W. $1/2$ S. 4 miles.
 3 fm. Hard ground. Short, narrow-leaved Zost.
- $10/7$ 99. E. by N. of Hurup.
 3 fm. Living Zost. and a little Dead Weed.
 2 fm. Living Zost. and Dead Weed.
- $25/7$ 01. Muldbjerge in N.W. by N. 6 miles.
 3 fm. Hard ground. Short, narrow-leaved Zost., many dead leaves.
- $28/6$ 97. Als church in S.W.W. by W. $1/2$ W. Jutland Aas in N. $1/2$ W.
 5 fm. Stony sand ground. Zost.
- $28/6$ 97. Als church in W.S.W. Muldbjerge in N.N.W. $1/2$ W.
 $3\frac{3}{4}$ fm. Sand ground. Plenty of Zost.
- $31/7$ 01. Als church in W.S.W. $9\frac{1}{2}$ miles.
 $5\frac{1}{2}$ fm. Pure sand ground. A little short and narrow-leaved Zost.
- $16/8$ 00. Als church in W. $1/2$ S. $6\frac{1}{2}$ miles.
 4 fm. Patches of short and narrow-leaved Zost. on sand ground.
- $16/8$ 00. Als church in W. by N. $3/4$ N.
 $5\frac{1}{2}$ fm. Sand ground. No Zost.
 5 fm. Zost.
- $20/7$ 00 16 miles E. of Mariagerfjord.
 7 (?) fm. Zost.
- $31/7$ 01. Sødringholm Wood in W. $1/2$ S., Stavnsbøved i S. $1/2$ E.
 $6\frac{1}{2}$ fm. Clay mixed with sand. No Zost.
 N.B. The white disc to be seen to a little more than $5\frac{1}{2}$ fm.

- ²⁵/₇ 01. Randers Fjord at Udbyhøj.
 a) in the stream, no Zost.
 b) at the edge from ca. $\frac{1}{2}$ — $\frac{1}{4}$ fm., dense growth of long, narrow-leaved Zost.
 c) $\frac{1}{4}$ —0 fm. Scattered growths of Zost. nana and Ruppia.
- ¹³/₇ 99. N. by W. of Treaa Mølle. $4\frac{1}{2}$ miles.
 3—2 fm. Zost.
- ²¹/₇ 01. Treaa Mølle in S. 2 miles.
 $4\frac{1}{2}$ fm. Sand ground. Scattered, rather short, medium broad Zost., a little Furcellaria.
- ³¹/₇ 01. In the middle of Gjerrild Bugt.
 $4\frac{1}{2}$ fm. Stones with Halidrys, Desmarestia viridis, Ectocarpus etc. No Zost.
 From a little more than 4 to 3 fm. Sand ground with very small and scattered patches of short and narrow-leaved Zost.
- ³¹/₇ 01. Off Havknude (South side).
 5 — $3\frac{1}{2}$ fm. Stony ground. Fucus, Furcellaria and other algæ (e. g. Corallina), mixed with very little Zost.
- ³¹/₇ 01. Off Draaby.
 6 — $5\frac{1}{2}$ fm. Stones with Fucus etc. No Zost.
 5 — $3\frac{1}{2}$ fm. Sand ground with stones. No Zost.

Dead Weed.

- ¹²/₁₀ 97. E. of Marens Reef.
 10 fm. A little brown Zost.
- ¹³/₇ 98. N.W. of the Northern Rønner. 5 miles.
 23—20 fm. Much Dead Weed.
- ²⁹/₇ 98. N.W. of Northern Rønner. 4 miles.
 18—16 fm. Dead Weed.
- ²³/₇ 00. Northern Rønner in S. by E. $\frac{1}{2}$ E. Ca. 5 miles.
 $17\frac{1}{2}$ fm. Dead Weed (Root-stocks and Roots) in quantities.
- ²³/₇ 00. E. of Sæby (Sæby church in W.S.W.).
 24—13 fm. A good quantity of Dead Weed.
- ²⁰/₇ 00. Sæby in W. 6—7 miles.
 11 fm. Lots of Dead Weed.
- ²²/₈ 98. Between Trindelen lightship and »Trekosten«.
 Ca. 20 fm. A quantity of Dead Weed.
- ²³/₈ 98. Off »Trekosten« N.E. of Læsø.
 20 fm. Dead Weed.
- ²⁶/₈ 98. 4 miles N. of Kobbergrunden lightship.
 40—25 fm. Dead Weed.
- ²⁶/₈ 98. 1 mile N. of Kobbergrunden lightship.
 17—10 fm. Lots of Dead Weed.
- ²⁶/₅ 97. Anholt lighthouse in S.W. $\frac{1}{2}$ S. 7 miles.
 23 fm. A quantity of Dead Weed.
- ¹²/₉ 99. E. by N. of Udbyhøj Baake. $2\frac{1}{2}$ miles.
 4 fm. Lots of Dead Weed.
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4. The waters between Jutland and Samsø, and Aarhus Bay.

- ²⁷/₉ 01. W. of Moselgrunden at Hjelm.
 6 fm. Living Zost.
- ²⁷/₉ 01. N.W. of the white broom at the light buoy on Moselgrund.
 5 fm. Dead Weed.
- ²⁴/₇ 01. Albagen at Ebeltoft.
 5—4¹/₂ fm. Broad-leaved, long Zost.
- ²⁴/₇ 01. Off Bagnsholm.
 5¹/₄ fm. The ground rather hard. Medium long and broad Zost.
- ²⁴/₇ 01. E. of Lushage.
 3 fm. Patches of sand on Zost. ground.
- ²⁴/₇ 01. W. side of Sletterhage.
 6 fm. Hard ground. No Zost.
- ²⁶/₈ 99. Helgenæs.
 4—3 fm. Plenty of Zost.
- ²⁶/₈ 99. Begtrup Vig.
 4¹/₂ fm. Zost.
- ³⁴/₇ 01. Molshoved.
 Ca. 3 fm. Spotted sand ground, chiefly Zost. (medium long and broad), a little Fucus vesic.
- ²⁴/₇ 01. Ground S. of Skødshoved, Kjeldshoved to the E.
 3—2¹/₂ fm. Like the preceding.
- ²⁴/₇ 01. Off Skødshoved.
 7¹/₂—5¹/₂ fm. No Zost.
 5 fm. Very long and broad-leaved Zost.
- ²⁴/₇ 01. Vosnæs Point.
 From 5 fm. inwards: long, broad-leaved Zost.
 At 2¹/₂ fm. bare patches occur in the up to now dense growth; Zost. shorter and narrower.
 The ground soft outwards, firmer nearer land.
- ²⁴/₇ 01. Off Egaa Point.
 6 fm. No Zost.
 5—4 fm. Plenty of Zost., meter-long, broad-leaved.
 3 fm. A little, rather short, but broad-leaved Zost. between Furcellaria and Fucus vesic.
- ²³/₇ 01. Off the S. end of Marselisborg wood.
 4¹/₂—2¹/₂ fm. Meter-long, broad-leaved Zost., nearer shore with large, bare spots.
- ²³/₇ 01. Off Kysing Hage (Norsminde Flak).
 5¹/₂ fm. No Zost.
 5—4 fm. Large, broad-leaved Zost., but a little shorter than the preceding.
- ²³/₇ 01. Off Dyngby Hage.
 6—5¹/₂ fm. No Zost.
 5—2 fm. Densely growing, long, broad-leaved Zost.
 At 2 fm. Bare patches and harder ground. Zost. a little shorter.
- ²⁶/₈ 99. W. of Tunø.
 4—3 fm. Zost.
- ²⁶/₈ 99. N. of Hou Harbour.
 4 fm. Long Zost.
- ²³/₇ 01. E. of Soby Reef, S. of the channel at Hou.
 3 fm. Long, broad-leaved Zost.
- ²³/₇ 01. A little S. of the broom on Søgrund, towards Svanegrund.
 4 fm. Large, broad-leaved Zost. 2 m. long.

The whole area from W. of Endelave to Horsens Bay is evidently covered with broad-leaved Zost.

- $\frac{23}{7}$ 01. Between the brooms on Skomagergrund and Møllevinge.
3 fm. Large, broad-leaved Zost.
- $\frac{23}{7}$ 01. Asvig, off Sønderby Wood.
At 6 fm. No Zost. Soft ground.
Large broad-leaved Zost. at 5—2½ fm.
- $\frac{23}{7}$ 01. Off Ashoved, N.side.
At 5—2 fm. Densely growing large broad-leaved Zost., though further in with bare spots.
At 5—3 fm. it is very broad and nearly 2 m. long. At scarcely 2 fm. meter-long and a little narrower.
The ground certainly soft up to 2 fm.
- $\frac{23}{7}$ 01. Large patches with densely growing, rather short, narrow-leaved Zost. and a little Fucus vesic. along the whole S. coast of Endelave at 3½—2½ fm. The patches thickest at 4 fm. and scarcer towards land.
This sort of ground continues S.W. of Endelave in shallow water, but at 5½ fm., between Endelave and the broom at Lillegrund, bare ground (no Zost.).

5. Little Belt.

- $\frac{1}{6}$ 99. At Vaarsø in Horsens Fjord. (Enclosed water.)
1½—1 foot Mud ground. Even growth of narrow-leaved Zost.
The channel (6—9 foot) partly overgrown.
- $\frac{2}{6}$ 99. Enclosed water at »Skoven«. Horsens Fjord.
Ca. 1 fm. Zost.
- $\frac{25}{8}$ 99. Skærbæk on Kolding Fjord.
4—2½ fm. Long and broad-leaved. Zost.
- $\frac{16}{6}$ and $\frac{7}{11}$ 91. Kolding Fjord.
Up to 3½—3 fm. Thick growth of Zost.
- $\frac{22}{5}$ and $\frac{30}{12}$ 91. Fensø Sound.
Rich growth of long and broad-leaved Zost.
Under the land shorter and narrow-leaved Zost.
- $\frac{23}{4}$ 91. Gamborg Fjord.
Zost.
- $\frac{31}{8}$ 00. Flækøjet.
4—2½ fm. Very long, broad-leaved Zost. in large quantity.
- $\frac{31}{8}$ 00. Off Stenderup Hage.
Ca. 2½ fm. Medium-long Zost.
- $\frac{23}{7}$ 91. Gudsøvig.
Short and narrow-leaved Zost.
- $\frac{5}{6}$ 00. N. of Brandso.
5 fm. A little Zost.
- $\frac{7}{6}$ 00. N. of Avernakø.
8(?) fm. A little Zost.
- $\frac{9}{6}$ 00. The bay west of Faaborg.
1 fm. Fucus and Zost. with patches of bare sand.
Ca. ½ fm. Richer growths.
Nearer land scattered, narrow-leaved Zost. and Ruppia.
The same on the N.E.coast of Bjørnø.

Dead Weed.

- $\frac{5}{6}$ 00. N. of Brandsø.
 9—5 fm. Lots of Dead Weed.
 $\frac{5}{6}$ 00. Brandsø and Ivernæs.
 10 fm. Some Dead Weed.
 The whole Bredning N. of Brandsø seems to be full of Dead Weed.
 $\frac{12}{8}$ 99. W. of Horne Land.
 13 fm. Some Dead Weed.
 $\frac{6}{6}$ 00. Lyø Krog.
 13 fm. Much Dead Weed.
 $\frac{11}{6}$ 00. Avernakø church in W.S.W.
 8 fm. Lots of Dead Weed.
 $\frac{7}{6}$ 00. N. of Avernakø.
 Dead Weed.
 $\frac{7}{6}$ 00. N.E. of Søby.
 11 fm. Some Dead Weed.
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6. Odense Fjord.

- $\frac{30}{8}$ 00. On the outer side of Hals Odde.
 7—5 $\frac{1}{2}$ fm. No Zost.
 4—2 fm. Long and broad-leaved Zost.
 $\frac{20}{9}$ 00. Just outside »Gabet« in Midskovbugt.
 4—2 fm. Long and broad-leaved Zost.
 $\frac{20}{9}$ 00. Just inside »Gabet« in Midskovbugt.
 3—2 Fv. Long and broad-leaved Zost.
 $\frac{10}{8}$ 00. Midskovbugt.
 3 fm. Long and broad-leaved Zost.
 $\frac{32}{5}$ 99. At Dørholm.
 1— $\frac{2}{3}$ fm. Scattered growing Zost.
 $\frac{12}{5}$ 99. N. of Vigelsø.
 1 $\frac{1}{3}$ — $\frac{5}{6}$ fm. Scattered growing Zost.
 $\frac{12}{5}$ 99. N. of the landing stage at Vigelsø.
 $\frac{1}{6}$ fm. Zost.
 $\frac{12}{5}$ 99. At the end of the channel below Lumby.
 1— $\frac{2}{3}$ fm. Narrow-leaved Zost.
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7. Samsø Belt.

- $\frac{28}{9}$ 01. N. of Vejro.
 7 fm. Dead Weed.
 $\frac{1}{8}$ 01. Udsager Hage on Samsø.
 5—4 $\frac{1}{2}$ fm. Patches of Furcellaria etc. A little Fucus vesic., some short
 and narrow-leaved Zost.
 The same conditions observed at ca. 3 fm.

- $\frac{1}{8}$ 01. A little N. of Ballen.
 $5\frac{1}{2}$ Fv. Stony ground. Mostly *Furcellaria*, *Rhodomela* and *Laminaria saccharina*, some *Delesseria*, *Cystoclonium* etc., a little medium-long and -broad *Zost.*
- $\frac{23}{7}$ 01. Off Ljushavn on Samsø.
 $3\frac{1}{2}$ —3 fm. Hard ground with patches of narrow-leaved, rather short *Zost.*

8. Great Belt and Langeland Belt.

- $\frac{1}{8}$ 01. Off Horseklint.
 6— $5\frac{1}{2}$ fm *Furcellaria* etc., no *Zost.*
 $5\frac{1}{4}$ Fv. Long and narrow-leaved *Zost* in great quantity.
 From this depth and inwards; *Zost.*
- $\frac{1}{8}$ 01. S. of Bøgebjerg.
 5 fm. *Furcellaria* etc. Some Dead Weed, no living *Zost.*
 $4\frac{1}{2}$ fm. Plenty of *Zost.*, which continues to $2\frac{1}{2}$ fm., then scattered patches with sand and *Fucus vesic.*
- $\frac{1}{8}$ 01. From a little south of broom on Romsø Røn to Stavreshoved.
 Barely 5 fm. Hard ground. *Zost.* long, but rather small-leaved; dense growth over the whole place, but a few patches of sand and *Fucus vesic.*
- $\frac{1}{8}$ 01. Mollegrund.
 According to statement: *Zost.* everywhere between 5 and 3 fm.
- $\frac{19}{5}$ 99. N. of Kjerteminde Harbour, in the corner.
 5 Fv. A little living, but much dead *Zost.*
- $\frac{26}{10}$ 98. Off the Marine Hotel at Christianslund.
 $4\frac{1}{2}$ fm. Living *Zost.*
- $\frac{23}{8}$ 00 and $\frac{26}{9}$ 98. N. of Knudshoved.
 4—3 fm. Hard ground. A little *Zost.*
- $\frac{30}{5}$ 99. S.E. of Knudshoved.
 4 fm. *Zost.*
- $\frac{22}{8}$ 00. Off Slipshavn.
Zost. and patches with sand ground.
- $\frac{19}{9}$ 98. At the upper end of Nyborg Fjord.
 6—5 fm. No *Zost.*
 4—3 fm. Long, broad-leaved *Zost.*
- $\frac{10}{10}$ 98. In Holckenhavn Nor.
 $\frac{2}{3}$ — $\frac{1}{3}$ fm. *Zost.*
- $\frac{17}{9}$ 98. N.W. of Palegrund.
 6—5 fm. Living, long *Zost.*
- $\frac{4}{10}$ 98. Sprogø lighthouse in N.N.E. $\frac{1}{2}$ E., Nyborg Church in N.W. $\frac{1}{2}$ W.
 $4\frac{1}{2}$ fm. A quantity of *Zost.*
- $\frac{22}{8}$ 00. Off the S. end of Kajbjerg Wood.
 5—3 fm. Long and broad-leaved *Zost.*
- $\frac{5}{10}$ 98. Vresen Puller at the buoy.
 $5\frac{1}{2}$ —4 fm. *Zost.*
- $\frac{22}{8}$ 00. The same place.
 $3\frac{1}{2}$ —3 fm. Some scattered *Zost.* among *Fucus* etc.
- $\frac{29}{5}$ 00. Due W. of the broom at Vresen Puller.
Zost.
- $\frac{28}{9}$ 98. W. side of Vresen.
 7 (?)—4 fm. *Zost.*

- $\frac{2}{8}$ 01. E. side of Vresen Puller.
 $4\frac{1}{2}$ —4 fm. A little Zost. among Furcellaria, Fucus etc.
 3 fm. Plenty of Zost.
 $2\frac{1}{2}$ fm. A little Zost., mostly Fucus etc.
- $\frac{11}{9}$ 99. Off Kongshøj.
 Zost.
- $\frac{3}{9}$ 00. Within Stokkebæk Flak.
 5—4 fm. Much large Zost.
- $\frac{3}{9}$ 00. N. of Lundeberg Harbour.
 4—3 fm. Much long Zost.
 3— $2\frac{1}{2}$ fm. A little shorter Zost.
- $\frac{3}{9}$ 00. Off Skaarupøre.
 4—3 fm. Long Zost.
- $\frac{3}{9}$ 00. Inner side of Turø Reef, near the broom.
 $3\frac{1}{2}$ —3 fm. Some long Zost.
- $\frac{3}{9}$ 00. Lungebugten, Stenodde in W. by S.
 $4\frac{1}{2}$ —4 fm. Long Zost. and some Dead Weed.
 $2\frac{1}{2}$ fm. Not particularly large Zost.
- $\frac{7}{10}$ 98. »Trekosten« at Hou Sand.
 3 fm. Zost.
- $\frac{2}{8}$ 01. Off Hou.
 5 fm. Large Laminaria digitata, Furcellaria etc., few shoots of Zost.
 . $4\frac{1}{2}$ fm. Scattered Zost. among Laminaria, Furcellaria etc.
 3 fm. Plenty of Zost.
 2 fm. Patches of Zost. and Fucus.
 N.B. The white disc. seen to ca. 5 fm.
- $\frac{2}{8}$ 01. Off Nedergaard.
 $5\frac{1}{2}$ fm. Fair amount of long Zost., which continues to at any rate ca.
 ca. $2\frac{1}{2}$ fm., then a quantity of Fucus.
- $\frac{2}{8}$ 01. Off Spødsbjærg.
 $5\frac{3}{4}$ — $5\frac{1}{2}$ fm. Some long and medium-broad Zost.
 $4\frac{1}{2}$ fm. Plenty of Zost., like the preceding.
- $\frac{2}{8}$ 01. Off Kjelds Nor towards Døvnse Klint.
 $4\frac{1}{2}$ — $3\frac{1}{2}$ fm. Stony ground. A little small Zost., some Fucus.

Dead Weed.

- $\frac{18}{5}$ 99. The channel between Sprogø and Romsø.
 16—15 fm. A quantity of Dead Weed.
- $\frac{27}{10}$ 98. Sprogø lighthouse in S.E. and Nyborg Church above the W. end of Christians-
 lund Wood.
 A little Dead Weed.
- $\frac{29}{6}$ 00. Off Nordenhuse.
 10—9 fm. A little Dead Weed.
- $\frac{21}{8}$ 00. S. of Sprogø.
 11 Fv. Dead Weed.
- $\frac{29}{5}$ 00. S.E. of Sprogø.
 20—11 fm. Much Dead Weed.
- $\frac{18}{6}$, $\frac{28}{6}$, $\frac{13}{7}$ 00. Sprogø in N.N.W.
 12—11 fm. Much Dead Weed.
- $\frac{5}{7}$ 00. The Channel W. of Vresen.
 Much Dead Weed.
- $\frac{17}{5}$ 99. E. of Vresen.
 7—6 fm. Dead Weed.

- $22\frac{1}{4}$ 00. Off Vresen Puller.
13 fm. A little Dead Weed.
- $1\frac{1}{10}$ 98. Knudshoved in N. by W. $\frac{3}{4}$ W. and Vresen broom in N.E. $\frac{3}{4}$ E.
 $8\frac{1}{2}$ fm. Dead Weed.
- $3\frac{1}{4}$ 00. Turo Reef's Inner side, near the broom.
6—5 fm. Soft ground. Dead Weed.

9. The north coast of Zealand.

- $23\frac{1}{7}$ 01. Off Hestehavegaard on the N. side of Refsnæs.
3 fm. Hard ground. Fucus vesic. and short, narrow-leaved Zost. in patches.
- $24\frac{1}{7}$ 01. Off Little Vroøj.
4—3 Fv. Sand ground with small stones. Fucus vesic., Furcellaria, Phyllophora, Delesseria etc. in patches. No Zost.
 $2\frac{1}{2}$ fm. Fucus vesic. and short, narrow-leaved Zost. in patches.
- $23\frac{1}{7}$ 01. Off N.W. corner of Nexelo.
 $3\frac{1}{2}$ —3 fm. Sand ground. Spots of Fucus vesic., Chorda and short, narrow-leaved Zost.
- $23\frac{1}{7}$ 01. In Nexelo Bay off Havnsø.
4— $2\frac{1}{2}$ fm. Soft ground. Thick growth of long and broad-leaved Zost.
 $1\frac{1}{2}$ — $1\frac{1}{2}$ fm. Hard ground. Rather thick growth of short and narrow-leaved Zost., furthest in only patches of Zost., Chara and Ruppia.
- $22\frac{1}{7}$ 01. N.E. of Kongstrup at Sejersø.
4—3 fm. Sand ground. Single patch of narrow-leaved Zost., stones with Fucus, Furcellaria etc.
- $22\frac{1}{7}$ 01. Through Snækkeløb at Zealand Odde and southwards: scarcely any Zost. because the ground, where visible was pure sand and with small patches of Fucus.
- $22\frac{1}{7}$ 01. Odden Church in S.
6—4 fm. No Zost., but Fucus, Furcellaria, Halidrys etc.
- $22\frac{1}{7}$ 01. In Nyrup Bay, E. of Klintebjerg.
 $3\frac{1}{2}$ — $2\frac{1}{2}$ fm. No growing Zost., but a few loose, old leaves; patches of Fucus, Furcellaria and Halidrys.
- $22\frac{1}{7}$ 01. Grønne Revle.
Bare sand ground. Like the preceding. No Zost.
- $22\frac{1}{7}$ 01. Off Spodsbjerg.
4 fm. Gravelly and stony ground. Single patches short, narrow-leaved Zost. For the rest Fucus, Furcellaria etc.
- $22\frac{1}{7}$ 91. Off Tidsvilde Leje.
5—4 fm. No Zost., but Fucus, Furcellaria etc.
- $22\frac{1}{7}$ 01. Off Gilbjergshoved.
 $4\frac{1}{2}$ —4 fm. Like the preceding.
- $22\frac{1}{7}$ 01. Off Hornbæk. Due W. of the boat harbour.
Hardly 5 fm. Sand ground. Large, rather broad-leaved Zost. in small quantity.
 $4\frac{1}{2}$ — $3\frac{1}{2}$ fm. Patches of strong, but rather short and narrow-leaved Zost. Here and there Fucus, Furcellaria etc.

11. The Sound.

- $20/7$ 01. Off Snækkersten.
4 $\frac{3}{4}$ —3 $\frac{1}{2}$ fm. Plenty of long and broad-leaved Zost.
- $20/7$ 01. Off Humlebæk.
4—3 $\frac{1}{2}$ fm. The ground rather soft. Rich growth of broad-leaved Zost. with scattered Rhodomela.
- $20/7$ 01. Nivaa Bay.
5—4 $\frac{1}{2}$ fm. No Zost.
4—2 fm. Sand ground with bare spots varied by growths of Rhodomela and scattered Zost.
- $20/7$ 01. Off Rungsted landing stage.
4—2 $\frac{1}{2}$ fm. Sand ground with large patches of Rhodomela, mixed with scattered, rather small Zost.
- $20/7$ 01. Off Skodsborg landing stage, N. side.
4—3 $\frac{1}{2}$ fm. Rhodomela-ground mixed with scattered long and broad-leaved Zost.
- $20/7$ 01. Between Taarbæk Reef and land.
3 fm. Rhodomela-ground at many places, with scattered long and broad-leaved Zost.
- $20/7$ 01. E. and S.E. of Klokke-tonden on Saltholm Flak.
4—2 $\frac{1}{2}$ fm. Almost nothing but *Fucus serratus*, *Furcellaria* etc., a very little short Zost.
- $20/7$ 01. Within the broom at Ryggen, Saltholms Flak.
3 fm. Scattered, medium-long Zost.
In the channel, inner side, no Zost.
On Flakket (2 fm.) very little short Zost., mostly *Ectocarpus*, *Chorda* and *Fucus serratus*.
- $20/7$ 01. Alongside Saltholm, off the landing stage.
Gravelly and stony ground.
3 fm. A little rather broad-leaved Zost., but mostly *Ectocarpus* etc.
2 fm. A little, narrow-leaved, low Zost., mostly *Ectocarpus*, *Fucus* etc.
- $20/7$ 01. Within the barrel on Kastrup Knæ.
3 $\frac{1}{4}$ —2 $\frac{1}{2}$ fm. Plenty of broad-leaved Zost.
- $20/7$ 01. Within the broom on Svalerumpe.
4—3 fm. in the Channel; no Zost., but Rhodomela, *Ectocarpus* etc.
Zost. commences singly at 3 $\frac{1}{4}$ fm.
3 fm. Plenty of broad-leaved Zost.
- $20/7$ 01. »Enkosten« at Sundbyhage.
4 $\frac{1}{2}$ —4 fm. Scattered, broad-leaved Zost., mostly *Ectocarpus*, *Chorda*, *Laminaria sacch.*, *Delesseria sanguinea*.
3 fm. Plenty of broad-leaved Zost.
- $20/7$ 01. Between »To-« and »Trekosten« on Middelgrund.
2 fm. Long, broad-leaved Zost., covering the ground.
- $20/7$ 01. Within »Trekosten«, at Provesten.
5 fm. No Zost.
3 $\frac{1}{4}$ —3 fm. Broad-leaved Zost.
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12. Smaaland Waters.

- 27/7 99. Aggersø Sound.
22—6 fm. Dead Weed.
5—2 fm. Dark sand ground. Zost.
- 30/5 00. Dybe Rende, S.E. of Aggersund.
16—10 fm. Dead Weed.
- 7/8 01. Helleholm lighthouse in N.W. $\frac{1}{2}$ N. 2 miles.
Fully 5 fm. No Zost., but Rhodomela, Ectocarpus, Furcellaria etc.
5—4 $\frac{1}{4}$ fm. Rather long and broad-leaved Zost. among Algæ.
3 fm. Plenty of Zost., a little narrower, but nearly the same length.
N.B. The white disc seen at exactly 5 fm. in the ca. 13 fm. deep channel.
- 7/8 01. At the barrel on Omø Tofte.
Ca. 5 fm. Long, medium broad-leaved Zost.
2 $\frac{1}{2}$ —2 mf. Sand ground. Patches of rather short, but strong Zost., covered by lots of Mytilus.
- 7/8 01. E. side of Omøs Staalgrunde.
Ca. 4 $\frac{1}{2}$ fm. Plenty of Zost., with the same appearance as at the just mentioned stations.
- 7/8 01. Basnæs i N. by E. 3 miles.
Zost. grows out to 4 $\frac{3}{4}$ fm.
4 fm. Plenty of long and broad-leaved Zost.
- 30/5 00. S. of Glæno.
7—6 fm. Much Dead Weed.
4—2 fm. Zost. and Fucus among large, bare spots.
- 7/8 01. Kirkegrund.
5—4 $\frac{1}{2}$ fm. No Zost.
Hardly 4 $\frac{1}{2}$ fm. Rather long and broad-leaved Zost.
- 7/8 01. Venegrund.
Like the preceding.
All plants taken at the stations between Venegrund and Omø had a rich growth of Membranipora and Ectocarpus on the older leaves.
- 7/8 01. Off Knudsbj.
5—3 $\frac{3}{4}$ fm. No Zost.
3 $\frac{1}{2}$ —3 fm. Ground mixed with sand. Rich growth of medium long and broad Zost.
- 7/8 01. S. side of Knudshoved Pynt.
Ground mixed with sand. Zost. goes out to 3 $\frac{1}{2}$ fm.
- 3/8 01. Off Kragenes Harbour.
5 $\frac{1}{2}$ —3 $\frac{1}{2}$ fm. Bare mud ground. No Zost.
3 fm. Long and broad-leaved Zost.
N.B. The white disc only seen at 1 $\frac{1}{4}$ fm., owing to rough water.
- 3/8 01. Fæmø Sound, between Skopen and Middelgrund.
4 fm. Bare mud ground. No Zost.
3—2 fm. Plenty of long and broad-leaved Zost.
- 3/8 01. At Leda Grund.
4 fm. No Zost.
3 fm. Long and broad-leaved Zost.
- 3/8 01. Vigso Church in W., Guldborg L. in S. by E. $\frac{1}{2}$ E.
3 fm. Scattered long and broad-leaved Zost. in an undergrowth of loose Cladophora rupestris.
At ca. 3 fm. Plenty of large Zost.

13. Guldborgsund.

- $\frac{3}{8}$ 01. Off Majbølle-isle, S. of Grummers Nakke.
5—3 fm. No Zost.
The sand bed rises suddenly to a depth of 1 fm.; plenty of large Zost.
- $\frac{3}{8}$ 01. Bredningen off Klodskov.
4— $3\frac{1}{4}$ fm. No Zost.
 $2\frac{1}{2}$ fm. Medium long and broad Zost. on mud ground.
- $\frac{5}{8}$ 01. Between Hasselø and Kalvø, in Hasselø Bredning.
Ca. $1\frac{1}{6}$ Fv. Hard ground. Rather short and narrow-leaved Zost.
- $\frac{5}{8}$ 01. Flinthorne Reef in N. by E. $1\frac{1}{2}$ E.
3 fm. Soft ground. Long and broad-leaved Zost., and Furcellaria.
- $\frac{5}{8}$ 01. Flinthorne Reef in N.N.E.
 $3\frac{1}{2}$ mf. Soft ground. No Zost.
N.B. The white disc seen at nearly 3 fm. Quiet water, apparently clean and transparent.
- $\frac{5}{8}$ 01. Nysted Church in N. by N. $1\frac{1}{2}$ N.
2 fm. Soft ground. Long and broad-leaved Zost.
- $\frac{5}{8}$ 01. Inner side of Rødsand at Fugleholm.
3 to a little less than 3 fm. Soft ground. »moss« (*Cladophora rupestris*, *Furcellaria*, *Rhodomela* etc.). No Zost.
 $2\frac{3}{4}$ — $1\frac{1}{2}$ fm. Soft ground. Rich growth of long and broad-leaved Zost.
From ca. $1\frac{1}{4}$ fm. Bare sand ground with a very little Zost. spots outwards.
- $\frac{5}{8}$ 01. Skjelby Church in N. by E. $1\frac{1}{2}$ E., Gedser Harbour lighthouse in S.E.
3 fm. »moss«. No Zost.
 $2\frac{3}{4}$ fm. Soft ground. Plenty of long and broad-leaved Zost.
N.B. The white disc was tried several times, but could never be seen at more than $2\frac{1}{2}$ — $2\frac{3}{4}$ fm.

14. Grønsund, Ulvsund and Bøgestrøm.

- $\frac{5}{8}$ 01. Skansepynt in Grønsund, Falster side.
2 fm. Hard ground. Short and narrow-leaved Zost.
- $\frac{5}{8}$ 01. N. of Skansepynt at the landing stage.
Hard ground. At the edge from ca. 2 fm. and inwards: large, rather narrow-leaved Zost.; besides *Potamogeton pectinatus*, *Ruppia*, *Chara baltica* and *Tolypella*.
- $\frac{6}{8}$ 01. Off Farø Jord
Ca. $1\frac{1}{2}$ fm. Rich growth of medium long and broad-leaved Zost.
- $\frac{6}{8}$ 01. N. of Tærø W. end.
4—3 fm. No Zost.
2 fm. Soft ground. Rich growth of medium long, broad-leaved Zost.
- $\frac{6}{8}$ 01. N. of Borren.
4—3 fm. No Zost.
2 fm. Like the preceding.
- $\frac{6}{8}$ 01. N. of N. Knigge.
 $1\frac{1}{2}$ fm. Soft ground. Like the preceding.

- $\frac{6}{8}$ 01. W. of Lange Grund
 $2\frac{1}{4}$ fm. and inwards. The same rich growth. Scattered with Zannichellia and Chara baltica.
- $\frac{6}{8}$ 01. At the S. end of the channel off Stavreby.
 $1\frac{1}{2}$ — $1\frac{1}{4}$ fm. Like the preceding. A quantity of Chara baltica.

15. The western Baltic.

- $\frac{13}{6}$ 00. Olenburg Huk in W. by N. 10 miles.
 15 fm. Dead Weed.
- $\frac{13}{6}$ 00. Eastern Mærker in N. $\frac{3}{4}$ E.
 12 fm. A little brown Zost.
- $\frac{13}{6}$ 00. Nearly N. of Eastern Mærker.
 $2\frac{1}{2}$ fm. A little Zost.
- $\frac{5}{8}$ 01. S. of Gjedser lighthouse.
 3 — $2\frac{1}{2}$ fm. Hard ground. No Zost.
- $\frac{5}{8}$ 01. Gjedser lighthouse in W. $\frac{3}{4}$ S.
 Ca. 4 fm. Hard ground with stones. No Zost.; some red Algæ (»moss«).
- $\frac{5}{8}$ 01. Vigersløse Church in N.W. $\frac{1}{2}$ W. 4 miles.
 $4\frac{1}{2}$ fm. Stone ground. No Zost.; the same fine »Moss« (Ectocarpus, Polysiphonia, Rhodomela etc.), a little Fucus.
- $\frac{5}{8}$ 01. Vigersløse Church in N.W. $\frac{1}{2}$ W. $5\frac{1}{2}$ miles.
 6 fm. Bare sand ground with few stones. No Zost.
 NB. The white disc seen at 4 fm.
- $\frac{5}{8}$ 01. Tromnæs i N.W. $\frac{1}{2}$ W.
 $5\frac{1}{2}$ fm. Stone ground with delicate Algæ. Some single shoots of Zost.
 5 fm. The same. The same.
 A little less than 4 fm. A few short and narrow-leaved Zost. A quantity of Tolypella.
 $3\frac{1}{2}$ —3 fm. The red Algæ less numerous, scattered Zost. and Fucus vesic.
 $2\frac{1}{2}$ fm. Scattered Zost. and plenty of Fucus vesic.
 Zost. is of the same kind at all the depths examined.
- $\frac{5}{8}$ 01. Off Pomlenakké.
 $2\frac{1}{2}$ fm. Large, bare places. Fucus vesic. and a little short and narrow-leaved Zost.
- $\frac{5}{8}$ 01. Hesnæs Bay.
 $2\frac{1}{2}$ —2 fm. Large, bare sandy patches. Like the preceding, but with a little more Zost. and Zannichellia.
- $\frac{6}{8}$ 01. Off the barrel in Bøgestrom in Faxe Bay.
 2 fm. Sand ground with stones. Patches of short, narrow-leaved Zost., Tolypella, Chara baltica and Fucus vesic.
- $\frac{6}{8}$ 01. In the Middle of Faxe Bay.
 6 fm. Sand ground. No Zost.
 NB. The white disc seen at $4\frac{1}{2}$ fm.
- $\frac{6}{8}$ 01. Feldskov E. point in N.E. by E. 2 miles.
 5 fm. Sand ground with fine red Algæ. No Zost.
 $3\frac{1}{2}$ fm. Stones with Fucus vesic. A few short, narrow-leaved Zost.

- $\frac{6}{8}$ 01. Off Faxø.
Ca. 4 fm. Sand ground. Rich quantities of fine red Algæ and a little narrow-leaved Zost.
- $\frac{6}{8}$ 01. Faxø in N. by W. $\frac{3}{4}$ W. 3 miles.
At a little less than 4 fm. Fucus and stones.
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16. Around Bornholm.

- $\frac{25}{6}$ 01. The Bay N. of Salthammer Reef.
Close to land. Sand ground. No Zost.
- $\frac{10}{7}$ 01. Zost. grows in small patches at $\frac{2}{3}$ fm. off Øleaa.
- $\frac{11}{7}$ 01. At Rønne: Zost. grows in low water in small patches with Potamogeton pectinatus, Myriophyllum, Ruppia, Zannichellia and Characeæ.
Inside the reef on sand ground, ca. 4 fm., a small quantity of Zost.

(Zost. is not mentioned in all the other reports from Dr. Mortensen's expedition round Bornholm 1901.)

N. H. Bergstedt (Bornholms Flora, Botan. Tidsskr. vol. 13, 1883, p. 152) mentions Zost. as »common at the coasts, but not in quantities«.



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